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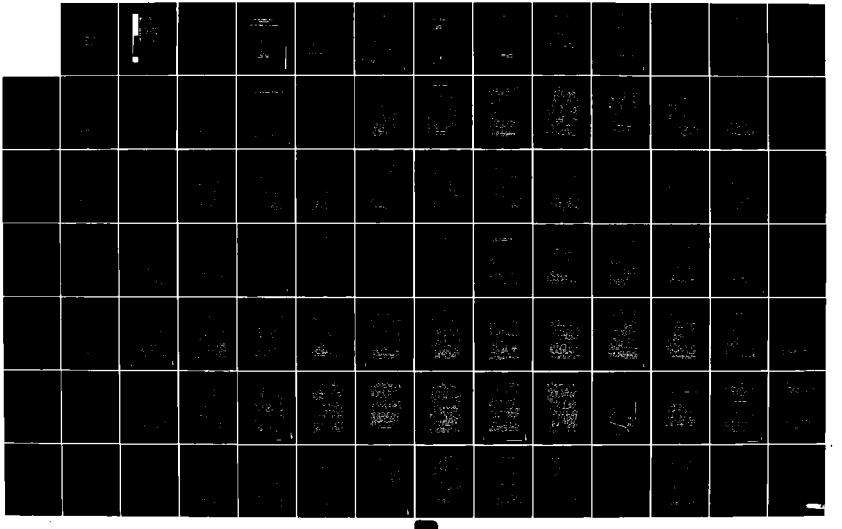

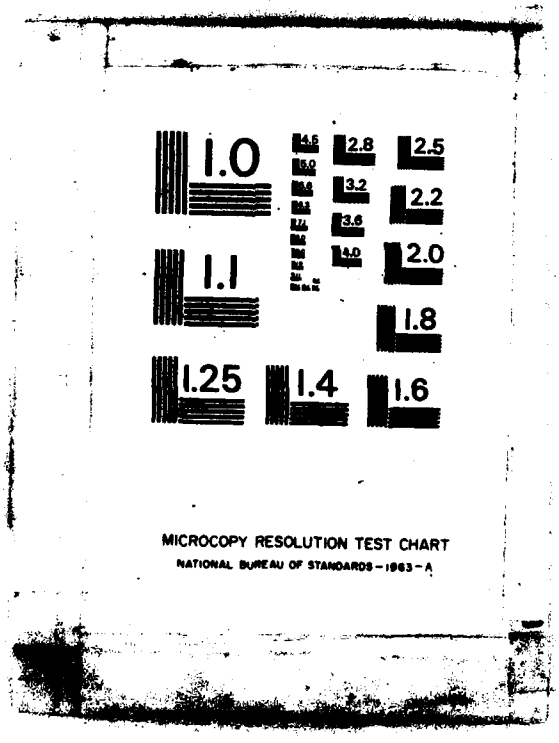
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THE NATIONAL SPACE PROGRAM

From the Fifties into the Eighties

CASS SCHICHTLE

the national defense university

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THE NATIONAL SPACE PROGRAM

From the Fifties into the Eighties

by

Colonel Cass Schichtle, USAF
Senior Research Fellow

National Security Affairs Monograph Series 83-6

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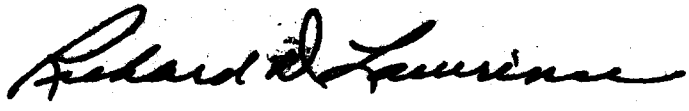
FOREWORD

Twenty-six years have passed since the launch of Sputnik I, and though the public fervor that then accompanied our nation's space programs has abated, progress has continued. Colonel Cass Schichtle, USAF, traces our vital national effort to make first and best use of space.

For the first time in twenty years, funding for space efforts in support of national defense has not only caught up with funding for NASA projects, it now exceeds it by nearly twenty-five percent. Recognizing that with the Space Shuttle as the nation's primary launch vehicle of the future, civilian and military space programs are being drawn inextricably together, Colonel Schichtle reaffirms the necessity for a comprehensive national space policy. He proposes a policy which will continue to set realistic goals for the civilian space agency and to support the new US Air Force Space Command.

This National Security Affairs Monograph should prove instructive and helpful to all students and policymakers concerned with—and responsible for—the future use of space.



RICHARD D. LAWRENCE
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ABOUT THE AUTHOR

Colonel Casper (Cass) J. Schichtle, Jr., United States Air Force, wrote this monograph while a Senior Research Fellow with the National Defense University and a student at the National War College. He is a distinguished military graduate of the AFROTC program at Drake University, where he received a bachelor of arts degree in mathematics. Under the sponsorship of the Civilian Institutions Division of the Air Force Institute of Technology, he received a master of science degree in operations research and statistics from Texas A&M University. As the first recipient of that university's Fellowship for Scholarship Excellence, he earned a Ph.D. in operations research and management.

Colonel Schichtle is a parachutist and master navigator and holds several civilian flying certificates (Commercial Flight Navigator and Commercial Pilot with instrument and multiengine ratings). His flying experience includes three years of development testing of E-3A Airborne Warning and Control System (AWACS) aircraft while Deputy Air Force Plant Representative at the Boeing Company, Seattle, Washington. Other recent assignments include the Directorate of Engineering and Acquisition Policy and the Directorate of Program Control, Deputy Chief of Staff for Systems, Headquarters, Air Force Systems Command at Andrews Air Force Base. Colonel Schichtle is currently Director of Engineering and Projects for the Ballistic Missile Office at Norton Air Force Base.

PREFACE

This monograph traces the National Space Program and its confusing history from the 1950s to the 1980s. Its focus is the Government agencies charged with leading this nation's public and military programs, the National Aeronautics and Space Administration (NASA) and the Department of Defense (DOD), respectively.

Although the legal role each agency plays can be found in the Space Act of 1958, the programs each pursues are most governed by national space policy. Thus, the central theme of this work is civilian and military space policies and the organizational changes that have been required to implement them.

The introduction and chapter 1 review events and influences that have been part of the complex space policy formulation process. Chapter 2 presents a rather detailed evolution of the National Space Program through past administrations for an understanding that is essential to put current issues into proper perspective.

To keep this work unclassified, there is no mention of the intelligence community's space work, and program-specific data on military space systems are kept to a minimum. (This self-imposed restriction limited the research to primarily open literature.)

Of the many space experts formally interviewed and the nearly 100 authors cited, Arthur L. Levine's *The Future of the US Space Program* (New York: Praeger Publishers, 1975) influenced this volume the most. A former NASA employee and at present a university professor, as well as a noted author, Mr. Levine holds views on the formulation of civilian space policies through the Nixon administration and prognostications for the future that were particularly incisive and helpful to me. To him, therefore, goes my first debt of gratitude.

This research would not have been possible without the further help and generous cooperation of the Congressional Research Service, especially Marcia S. Smith of the Science Policy Research Division. An author and specialist in energy and aerospace systems, Ms. Smith answered my many questions and provided literally volumes of information. I received valuable criticism from Colonels Charles Heimack, Robert Giffen, Christopher Branch, and Stu Perkins and Captain Robert Reed (USN), fellow students at the National War College, each of whom read a draft of the monograph. Special credit is due Colonel Fred Kiley, Professor of Research and, hopefully, a personal friend for many years to come, as well as the entire National Defense University Research Directorate, for reviewing, editing, and bringing this effort to press.

Of greatest importance, I am grateful for the patience, understanding, and moral support of my wife, Linda, and my children, Julie, Chris, Mark, Nick, Matt, and Cassie. The time I took away from them to write this monograph while completing the resident National War College curriculum can never be restored. Although too little compensation, I dedicate this research effort to them.

CASS SCHICHTLE

INTRODUCTION

In July 1975, US and Soviet astronauts flew together in space, a historic first in international space cooperation. In contrast to the competitiveness of the 1960s, the Apollo-Soyuz Test Project (ASTP) demonstrated that nations could and should use space as a common ground for peaceful purposes and the amelioration of the human condition.

The beneficial aspects of the US space sciences and applications programs in providing early warning for natural disasters, predicting weather, increasing agricultural and mineral yields, monitoring pollution, improving worldwide communications and navigation, exploiting the untold riches of the oceans, and exploring the solar system have been well publicized. Given all these achievements mounted in the last decade, hopes blossomed that future efforts would be undertaken increasingly on an international basis. Prior to the Carter administration, projections seemed solid that by the late 1980s there would be one or more large space stations in earth orbit; there was a likelihood that citizens of many countries would be participating in various functions, including earth resources studies, manufacturing in space, weather and communications satellites, [illegible], and various [illegible]

[illegible]

United States was strictly limiting its military space projects to defense-support missions for early-warning systems, reconnaissance, communications, and navigation. Even though international agreements prohibited weapons of mass destruction in orbit and other aggressive uses of space, satellites and space stations obviously had potential military capabilities. If rival powers began to use space for potentially aggressive purposes, despite international agreements, the United States would have to reconsider its own military space posture.

Whether the US space program had a civilian or a military orientation depended on the Government's space policy. Similarly, whether the United States developed its space projects to compete with those of other nations or for noncompetitive uses—with or without the cooperation of other nations or international organizations—all depended on space policy. Within these alternatives, space policy also determined the priorities for exploration, science, and practical applications, and the role of manned space flight in each. Many factors other than military security entered into the governmental decisions that shaped space policy, such as international cooperation, technological prowess, scientific discovery, commercial applications, and national pride and prestige. These factors were molded chiefly by the National Aeronautics and Space Administration (NASA), the nation's civilian space agency, and the Department of Defense (DOD), especially the US Air Force. The influence enjoyed by NASA and DOD with the President, his staff agencies, and Congress, coupled with support from the aerospace industry, the scientific community, and the public, determined the thrust of the nation's space policy.

What happened? Official US policy towards space exploration fluctuated dramatically from the culmination of President Kennedy's mandate to land men on the moon by the end of the decade to the current policy of low-level space budgets with few projects and no space spectaculars.[1]

The 1970s witnessed a shift away from a manned space flight emphasis and toward unmanned "application" satellites. Not only were the last three Apollo lunar landing missions cancelled, the once ambitious Apollo applications program, renamed Skylab, was also reduced in scope to a single space station. The ASTP international space flight in July 1975 heralded the end of the Apollo era.

NASA acknowledged in the early 1970s that the "aerospace depression" had clearly begun and that the old days of "gung ho for space" were gone.[2] Despite this situation, on 5 January 1972 President Nixon made the scarcely noticed announcement that the United States would start development of the space shuttle. From 1976 to 1978, NASA faced cost and schedule problems on the space transportation system and, saddled with low-level funding, had to cut back in other endeavors. Consequently, space science and applications programs suffered and dreams of large civilian space stations orbiting in the 1980s dimmed.

Meanwhile, this period saw military programs rapidly expanding, with satellites being developed and launched for a variety of functions, including reconnaissance (photographic, electronic, early warning, ocean surveillance, and nuclear explosion detection), communications, navigation, meteorology, and geodesy.

The banner year for issues surrounding US activities in outer space proved to be 1981. The first two flights of the shuttle reminded the nation not only that it had a space program (no US citizen had gone to space in six years), but that space could be used for military as well as civilian activities. NASA's space shuttle is the point at which the civilian and military space programs clearly intersect. Not only is the shuttle America's major commitment to space exploration and exploitation, it is the first NASA spacecraft to have a military role.[3]

Developing policies and goals for DOD's military and NASA's civilian programs, and for interaction between the two, has become critical because of tighter budgets, since

many of the efforts seem duplicative. In addition, DOD's space budget authority has grown to exceed NASA's (table 1). With the advent of the space shuttle [illegible] wherein both agencies will be using the same launch system, clear distinctions between the two programs are blurring, and the possibility of merging them into one agency has arisen.[4]

Other issues about the Government's increasing role in space have surfaced and include NASA's operation of systems, such as the space shuttle, once the systems are out of the research and development phase[5] and the military space command. (The initial legislation for establishing a separate Air Force space command was introduced by Representative Ken Kramer (R-Colo.).[6])

In addition, the roles in space of other Federal agencies and the private sector are growing. The Department of Commerce, for example, has responsibility now for operating meteorological satellites and responsibility in the future for remote sensing satellites. Not only is a greater segment of private industry using space technology, such as communications satellites, one company (Boeing) is interested in operating space systems, such as the shuttle, directly.

Concurrently, space is becoming more international in character. China, India, Japan, and the Soviet Union have their own launch capabilities. In addition, the European Space Agency (ESA), a group of 11 European nations, is now testing its Ariane launch vehicle, which is expected to compete directly with the space shuttle for launching commercial payloads into space.

In the increasingly complex world of space policy, the nation no longer has one overall goal but rather a multipurpose program, encompassing both manned and unmanned flight, civilian science and applications, and military security. In subsequent chapters, this monograph traces the evolution of the civilian and military programs that have constituted the overall national space program. This, in turn, reveals the current stage of transition of national policy and military and civilian organizational postures.

Table 1. Space Activities of the US Government: 24-Yr Budget Summary—Budget Authority

Fiscal Year	NASA Total	NASA Space	Defense	Energy	Commerce	Interior	Agriculture	National Science Foundation	Total Space
1959	330.9	260.9	489.5	34.3	—	—	—	—	784.7
1960	523.6	461.5	560.9	43.3	—	—	—	0.1	1,065.8
1961	964.0	926.0	813.9	67.7	—	—	—	0.6	1,808.2
1962	1,824.9	1,796.8	1,298.2	147.8	50.7	—	—	1.3	3,294.6
1963	3,673.0	3,626.0	1,549.9	213.9	43.2	—	—	1.5	5,434.5
1964	5,099.7	5,016.3	1,599.3	210.0	2.8	—	—	3.0	6,831.4
1965	5,249.7	5,137.6	1,573.9	228.6	12.2	—	—	3.2	6,955.5
1966	5,174.9	5,064.5	1,688.8	186.8	26.5	—	—	3.2	6,969.8
1967	4,965.6	4,830.2	1,663.6	183.6	29.3	—	—	2.8	6,709.5
1968	4,587.3	4,430.0	1,921.8	145.1	28.1	0.2	0.5	3.2	6,528.9
1969	3,990.9	3,822.0	2,013.0	118.0	20.0	0.2	0.7	1.9	5,975.8
1970	3,745.8	3,547.0	1,678.4	102.8	8.0	1.1	0.8	2.4	5,340.5
1971	3,311.2	3,101.3	1,512.3	94.8	27.4	1.9	0.8	2.4	4,740.9
1972	3,306.6	3,071.0	1,407.0	55.2	31.3	5.8	1.6	2.8	4,574.7
1973	3,406.2	3,093.2	1,623.0	54.2	39.7	10.3	1.9	2.6	4,824.8
1974	3,036.9	2,758.5	1,766.0	41.7	60.2	9.0	3.1	1.8	4,640.3
1975	3,229.1	2,915.3	1,892.4	29.6	64.4	8.5	2.3	2.0	4,914.3
1976	3,550.3	3,225.4	1,963.3	23.3	71.5	10.4	3.6	2.4	5,319.9
1976T	931.8	849.2	460.4	4.6	22.2	2.6	0.9	0.6	1,340.5
1977	3,817.8	3,440.2	2,411.9	21.7	90.8	9.5	6.3	2.4	5,982.8

Table 1. Space Activities of the US Government: 24-Yr Budget Summary—Budget Authority—Continued

Fiscal Year	NASA Total	NASA Space	Defense	Energy	Commerce	Interior	Agriculture	National Science Foundation	Total Space
1978	4,080.1	3,622.9	2,728.8	34.4	102.8	9.7	7.7	2.4	6,508.7
1979	4,595.5	4,030.4	3,211.3	58.6	98.4	9.9	8.2	2.4	7,419.2
1980	5,249.2	4,680.4	3,848.4	39.6	92.6	11.7	13.7	2.4	8,688.8
1981 est.	5,519.1	4,997.2	4,789.4	42.0	91.9	12.1	15.5	2.4	9,950.5
1982 est.	6,118.3	5,617.3	5,916.3	38.0	126.3	12.6	17.2	2.0	11,792.7

Note: Amounts shown are in millions of dollars and exclude amounts for Air Transportation.
Source: Office of Management and Budget (December 1981).

1. POLICY DEVELOPMENT RETROSPECTIVE

On 2 November 1981, the *Los Angeles Times* published an article by Representative Edward P. Boland (D-Mass.), Chairman of the House Appropriations Subcommittee on Housing and Urban Development and Independent Agencies:

> If, the truth were known, never was this nation's space program beset by more uncertainty, greater disarray and a cloudier future in all its 30-year history.
>
> . . . it all comes back to a problem of dollars. It is not possible to squeeze a major shuttle development program and new planetary missions and aeronautical research out of a continually contracting budget.
>
> And so NASA is at the crossroads. Decisions must be made, and made soon, on the future role of the US civilian space agency. What will happen to the space shuttle? Will it become a $15 billion white elephant?
>
> Ironically, the shuttle may gradually evolve primarily into a military vehicle. That would be a particularly difficult pill to swallow because, in trying to hold the shuttle's funding harmless, nearly all NASA's science and applications programs are being sacrificed. That tragic and frustrating scenario appears to be the trend.
>
> In effect, we may be witnessing the gradual "militarization" of NASA. Sadly, we may see NASA become nothing more than an arm of the Department of Defense tasked with running a trucking company. That would abrogate to the Japanese and the Europeans many science applications and communications programs in the next decade. When one looks at the trends, it is hard to escape these conclusions.

> ... until a space policy is set out that succeeding Administrations and Congresses will stick with, we are going to continue to pay more for less.[1]

Two months later, the *Washington Post* quoted George Keyworth, the President's Science Advisor, from his speech before the American Association for the Advancement of Science: "The government must seek out the less productive research areas in science and sharply cut their funds.... Planetary exploration programs produce less hard science than other parts of the federal space science budget."[2]

Meanwhile, on the DOD side of the ledger, the Air Force has a freshly activated Air Force Space Command. However, at the time the bill was in Congress to rename the Air Force as the Aerospace Force (a motion which was declined) and set up a space command, the *Air Force Times* asked this question:

> Is it time to take the military space program out of the closet and expand it into a full-blown national effort? Or should we maintain the fiction that our only interest in space is scientific and exploratory and continue to let the military ride the civilian program on a space-available basis?
>
> While the Soviets make no bones about their military involvement in the area, we have clung doggedly to the position that ours is a peaceful, civilian effort "untainted" by military considerations.[3]

In addition, the *Air Force Times* reported criticism of DOD by the Government Accounting Office (GAO) in April 1982:

> The Defense Department has a limited view of space and isn't doing all it could to exploit that frontier....
>
> The United States should take immediate action to provide a capability to exploit space and protect our interests there....
>
> Although DOD said it views space as an adjunct to accomplishing other missions such as providing communications, surveillance, navigation and meteorological

support, presidential policy directives call for broader actions....

> These policies include: (1) maintaining the right of free access to space; (2) exploring and using space to support national well-being; and (3) pursuing space activities for national defense, deterrence of attack and arms control.
>
> Achieving these broad objectives ... requires the focus on space as a mission area, not a functional one as is the case today.[4]

One way of using space as a mission area was recommended by the conservative Heritage Foundation in March 1982. In its study, "High Frontier," the foundation proposed "a major shift in US defense strategy in which nonnuclear weapons shot from satellites in space ... would destroy Soviet missiles as they are flying toward the United States."[5]

While the militarization of NASA or the threat of it becoming an arm of DOD is remote, the steady erosion of space science and applications budgets, coupled with the unlikelihood of another Apollo or shuttle research and development effort, clouds the civilian space agency's future. Barring some catalytic event, such as Sputnik, that would focus national attention on another major space endeavor, NASA is destined to inherit only the roles of the nation's researcher for advanced aeronautical and space technology and the "point of contact" for international cooperative efforts in space.

Conversely, DOD's space efforts are expanding and its responsibilities are growing. Given the objective of DOD, to prevent war, particularly nuclear war, DOD must be prepared to wage war if necessary, even in space. Not to be prepared for this eventuality would be to deny both the Soviet threat and the lessons learned from the growth of air power. The GAO's criticisms notwithstanding, the Air Force has recognized the importance of space as a mission area for some time but is delinquent in updating its basic doctrine. It is time to expand the military space program into a full-blown national effort.

INTERNATIONAL AGREEMENTS

Soon after Sputnik 1, many countries realized that legal problems might evolve from new ventures into space. To date, this concern has resulted in four space treaties. (See appendix A.)

Space Treaties and Conventions

The first treaty to be signed was the "Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies" (more simply, the Outer Space Treaty or OST). First considered by the United Nations (UN) Committee on the Peaceful Uses of Outer Space in 1966, it entered into force on 10 October 1967. The OST was concerned with only general principles and did not involve details for effectuating the concepts it contained. The three treaties which followed expanded on its premises.

The "Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space" (Astronaut Rescue and Return Agreement) elaborated on articles V and VIII of the OST. After four years of consideration in the UN, it entered into force on 3 December 1968.

The third space agreement, "Convention on International Liability for Damage Caused by Space Objects," took the longest to ratify. Legal liability for damage was first considered by the UN in 1958, but the convention was not completed until 9 October 1973.

The latest international space agreement, "Convention on Registration of Objects Launched Into Outer Space," was based on the voluntary registration system that has been in operation since 1962. This convention established a mandatory system for centralized and public registry of all space objects and entered into force on 15 September 1976.

Agreements with Military Implications

The OST is currently the principal international agreement that deals with military space-related activities. Article IV of

the OST prohibits the placement of nuclear weapons or any other weapon of mass destruction in earth orbit, the installation of such weapons on celestial bodies, or the stationing of such weapons in outer space in any manner. It does not prohibit use of ICBMs with nuclear warheads in suborbit or fractional orbit. Although "weapons of mass destruction" is not defined, the generally accepted view is that they include nuclear, chemical, and biological weapons.

Article IV also specifies that the moon and other celestial bodies are to be used "exclusively for peaceful purposes." The Soviets have defined this phrase as "nonmilitary," while the United States has interpreted it more expansively as "nonaggressive." Although military personnel may be used for scientific research or any other peaceful purpose, certain specific activities are prohibited on celestial bodies, such as the establishment of military bases, installations, or fortifications; the testing of any weapon; and the conduct of military maneuvers.

There are other space agreements with military implications in addition to the OST. Article I of the Limited Test Ban Treaty of 1963 prohibits nuclear weapons tests or any other nuclear explosions in outer space.

Two provisions of the UN Charter were made especially applicable to space by article III of the OST. In their international relations, members of the UN may not use force against the territorial integrity or political independence of any state (article 2 (4), UN Charter). However, member states do have the inherent right of individual or collective self-defense if any armed attack occurs (article 51, UN Charter). The United States has traditionally maintained a broader right (i.e., military, economic, or political) to respond to any threat in self-defense, to act in anticipatory self-defense, or to act in self-defense to avoid accidental injury.

The Antiballistic Missile (ABM) Treaty of 1972 prohibits interference with reconnaissance satellite verification of treaty compliance (article III) and the development, testing, or deployment of space-based ABM systems and their components

(articles IV and V). The latter presumably includes radars for early warning of strategic ballistic missile attack.

Article I of the Environmental Modification Convention prohibits military or other hostile use of environmental modification techniques as the means of destruction, damage, or injury to any other state party if such usage has widespread (several hundred square kilometer area), long-lasting (several months or approximately a season), and severe effects (serious or significant disruption or harm to human life, natural and economic resources, or other assets). Environmental modification techniques are defined as any technique for changing through deliberate manipulation of natural processes the dynamics, composition, or structure of the earth or outer space.

The Moon Treaty was unanimously endorsed by the UN General Assembly in December 1979 and referred to member states for signature and ratification. As of the early 1980s, the United States has neither ratified nor signed the agreement, nor has the executive branch formally submitted the agreement to the Senate for its consent, nor does it appear likely to for some time to come. However, if it were to be ratified, the Moon Treaty would impose the following additional legal obligations:

First, it would extend prohibition on use of force or threat of use of force to "any other hostile act or threat of hostile act" in the area of treaty applicability (the moon, other celestial bodies except the earth, and orbits around and trajectories to or around those celestial bodies);

Second, it would extend "peaceful purpose" and related OST prohibitions to orbits around the trajectories to or around celestial bodies; and

Third, it would prohibit interference with activities of other states' parties in the area of treaty applicability.

Thus, US activities in space are conducted within the context of a body of international as well as domestic law. This limited body of bilateral and multilateral treaties, international

conventions, and international customs and practices directly influences space policy and activities.

From a military point of view, the most significant of these is the customary behavior toward space by the United States and Russia, until recently the only nation states capable of exploiting space. There are provisions in the OST, ABM Treaty, and the Limited Test Ban Treaty restricting specific types of military activities in space (weapons of mass destruction, interference with national technical means of treaty verification, development and deployment of a space-based ABM, and nuclear testing in space). With the exception of these provisions, nothing in the body of international space law specifically defines whether or not a particular use of space conforms to the general principle set down in the OST and the UN Charter. Since the OST recognizes the inherent national right of self-defense (as stated in article 51 of the UN Charter), the United States supports the concept of the peaceful use of space but interprets such use to mean *nonaggressive* in contrast to *nonmilitary*.

From a civilian point of view, there is considerable latitude for policy flexibility within this minimal regulatory regime. A basic objective of US civil space policy has been to conduct national programs to promote an international climate of legitimacy, acceptance, and minimal interference. The United States has carefully developed and maintained worldwide user communities in areas of launch assistance, remote sensing, weather service, telecommunications, and space sciences.

INTERNATIONAL PROGRAMS

In summarizing international efforts in space with countries other than the Soviet Union through 1978, Marcia S. Smith, a specialist in aerospace and energy systems for the Congressional Research Service, said

> the evidence shows clearly that the United States still has a lot more it could do to make the best use of talents in other countries. How much we can accomplish in this

> area depends primarily on the strength of NASA's budget in the coming years.[6]

With respect to joint efforts with Russia, success in the past is best summarized by this forecast for the future:

> . . . cooperation with the Soviet Union is still welcomed by many US scientists, but their Russian counterparts had better be fully prepared to cooperate or be left out of future US activities. This attitude generally characterizes the current US position regarding space cooperation with the Soviet Union: cooperation is beneficial and desirable, but the exchange must be reciprocal and unfettered by the incomplete information transfer evidenced in the past.[7]

Cooperation Yields [illegible] Benefits

Within the United States, international cooperation in space is principally the responsibility of NASA, through its International Affairs Division, and the Department of State (DOS), through the Technology Policy and Space Affairs Office of the Bureau of Oceans and International Environmental and Scientific Affairs. There are primarily two ways in which international programs materialize: a foreign agency expresses a desire to NASA to participate in a certain program or a program office or field center within NASA develops a program conducive to international cooperation and suggests it to the division and vice versa.

Once negotiations have been completed between NASA and the foreign agency involved, agreements can take several forms:

Executive Agreement (or Intergovernmental Agreement). [illegible]

Agency-level Memorandum of Understanding [illegible]

Letter Agreements, used for programs such as experiments on NASA satellites and signed by NASA's International Affairs Division and its foreign counterparts; and

Lastly, *informal projects*, conducted without signed agreements. (They account for a significant percentage of NASA's cooperative efforts.)

Only Executive Agreements must be processed through DOS, but NASA also obtains State Department concurrence on Memoranda of Understanding and informs DOS of its intention to formulate Letter Agreements.

NASA offers two types of arrangements for launching foreign payloads: cooperative agreements and reimbursable agreements. Under the cooperative arrangement, the United States provides the launch vehicle and services free of charge in return for access to resulting scientific information. No exchange of funds takes place between the two countries, and each is responsible for its own contribution. Under the reimbursable arrangement, NASA charges the user for launch services and the travel expenses of joint working group participants, and since 1976 NASA has attempted to recover certain indirect costs, such as project management, engineering support, depreciation, and research and development.

From 1962 through 1978, there were nearly 40 cooperative launches with a wide variety of stated purposes. They included ionospheric studies, atmospheric physics, radio astronomy, solar astronomy and cosmic rays, particles and fields, atmospheric studies, investigations of wind speeds at various altitudes, electric and magnetic fields, galactic X-ray sources, properties and processes in the vicinity of the sun, experimental communications, interactions of interplanetary media with the earth's environment, and ultraviolet explorations.

In the 10-year period from December 1968 to December 1978, there were approximately 60 reimbursable launches with understandably less descriptive purposes. Nearly 80 per-

cent dealt with communications (military, domestic, experimental), and the others included interplanetary magnetic fields, solar and cosmic rays, meteorology, and extraterrestrial gamma ray studies. Nearly all of the western European nations participated plus Britain, Canada, Japan, Indonesia, NATO, and the European Space Agency.

Carefully constructed cooperative programs have yielded the benefits of access to foreign scientific and technological expertise, foreign research and development facilities, and foreign funds. This strategy has been successful for the United States in terms of foreign expenditures for the development of spacecraft for joint programs, construction of hardware for US spacecraft, and support of scientific experiments on joint missions. In addition, this strategy has not involved setting aside money specifically for international cooperative projects. Cooperation is carried out through participation in domestic projects competitively selected on their own merits and funded under domestic funding lines.

NASA continues to pursue cooperative ventures in space for at least three more reasons. First, in these tight budget times that all industrialized democracies are facing, no nation can afford to dominate all areas of scientific accomplishment. Collaboration on large-scale, high-cost science and applications programs provides the opportunity to pursue projects that might otherwise be too expensive.

Another reason for continuing cooperative space projects is less tangible, but still real. Meaningful participation by allied nations in high-visibility programs fosters the desired image of openness in US projects that effectively counters Russian attempts to cast suspicion. For instance, despite early objections to the US remote-sensing programs, the programs have now received widespread support because of the availability of the programs to all foreign nations. Lastly, cooperation is a factor in minimizing competitive pressure. For example, if a friendly nation develops a shuttle-compatible system, it not only supports the US effort but diverts foreign resources from competitive programs.

Competition from Foreign Efforts

The United States is observing aggressive pursuit of the space technology market by Europe and Japan in such areas as launch services, remote sensing, and telecommunications satellites. Foreign governments support competition pervasively by funding research and development, by price subsidization and financing, by development of attractive package deals, and by creation of government-backed marketing organizations.

Industry to government relationships in other countries differ greatly from those in the United States. Although the private sector is active, their government intervention acknowledges limitations on the ability of the private sector to support research, development, and operational costs for projects of the magnitude required by space. Aggressive upfront money by European and Japanese Governments has ensured their effective competition in the world market place. In Japan, the Ministry of Industry and Trade forms partnerships with Japanese industry on high risk, high technology projects and actively promotes international marketing. In France, the aerospace industry is actually 50 percent government owned.

In the area of launch services, when it becomes operational the European Space Agency's Ariane launch vehicle will move, if successful, into a traditional US preserve, reimbursable launch services. Through aggressive marketing, low prices, and attractive financing, the Ariane could operate at full capacity by 1986 and possibly capture up to 30 percent of the world market for reimbursable communications satellite launches.

In the area of remote sensing, competitive systems are beginning to proliferate, especially ground station hardware. While France and Japan are motivated by the prospects of commercial sales for their industries, some developing countries, like India and Brazil, are motivated by the political prestige of operating their own systems. Canadian, German, French, and Japanese companies have well developed product lines for ground receiving hardware and processing equip-

ment. Furthermore, a number of foreign firms offer data analysis and other value-added services, an area heretofore dominated by the United States.

Foreign international sales efforts often rely on comprehensive government aid packages and concessionary financing. In commercializing its remote-sensing satellite system, France has made a 10-year commitment to data continuity and government subsidies. While funding assistance is also active in Canada, Germany, and Japan, it has been the practice of the US Agency for International Development not to fund foreign acquisitions of remote sensing systems.

In the area of telecommunications, the ability of the US industry to continue to provide needed domestic and international services is contingent on rapidly expanding demands. Competition in this multibillion dollar market for telecommunications equipment is coming from European and Japanese firms. In these countries, government-industry teams and direct government-sponsored research and development serve to reduce perceived program risks and spur domestic industry in effective international competition.

SOVIET SPACE ACTIVITIES

As evidenced by recent actions, the Russians may choose to violate the provisions of the previously mentioned space treaties without notification or explanation. Clarence Robinson points out in *Aviation Week and Space Technology* the following Soviet record.

> (1) The Soviets have tested an air defense system in an antiballistic missile mode that is a clear violation of the ABM Treaty; (2) During recent war games, the Soviets exercised a 2–5 day reload procedure for the SS–18 heavy ICBM in violation of the SALT accord; (3) Tests of a new submarine-launched ballistic missile used encrypted telemetry that is also a violation of the SALT provisions; (4) A new Soviet air-launched cruise missile was tested from the *Backfire* bomber with a missile range greater than 600 km, the maximum distance per-

> mitted by the unratified SALT 2 agreement; (5) the SS–18 is clearly designed to carry 12–14 reentry vehicles, not the 10 limited by SALT 2.[8]

In addition,

> With the deployment of the flat twin movable ABM radar system, the new missile tested against RVs (reentry vehicles) and the battle management radar around Moscow, the Soviets are building toward a capability to break out of the ABM agreement with a clear-cut capability and leave the US behind.[9]

Overt defiance is not the only argument against the suggestion that international treaties can serve as an effective impediment to the introduction of strategic defensive weapons in space. Included within each of the three major treaties that most directly affect military applications in space are provisions for unilateral termination.

With respect to the Limited Test Ban Treaty, the ABM Treaty, and the OST, any of the signatories may withdraw after advance notices of three months, six months, and one year, respectively.[10] The United States would therefore have a maximum of one year to recover from a Russian announcement to deploy military weapons in space that fall within the constraints of international agreements. However, it is more ominous that the Soviets may not feel obliged by the provisions of military agreements, especially if distinct advantages can be gained from direct violation.

General Jacob E. Smart, USAF (Ret.), has recommended a policy to guide the national effort to overcome the Soviet threat:

> Today and henceforth the United States must be prepared to defend itself against aggression in space and from space. We cannot surrender the "high ground" without contest. We must be in space to acquire knowledge of what others are doing there and to prepare to counter that which threatens us.[11]

There are at least three reasons to believe that the Soviet space programs have direct military application. Under the

Soviet view of international conflict, space is considered a potential medium for warfare. Their view of war demands that the military potential of this arena not be ignored, because that would surrender an advantageous position to the enemy. Thus, space use is viewed in concert with other programs designed to enhance national power in the pursuit of national objectives.

Within the Soviet Union bureaucratic hierarchy there is only one agency that is capable of exploiting national objectives in the space medium—the Strategic Rocket Force (SRF). This situation is the result of at least two decades of Soviet policies that have made available to the Russian Armed Forces the men, material, and money required to build a military power capable of competing favorably with the United States. The SRF therefore has a monopoly on the human and technical resources required to design, develop, and employ Soviet hardware in space. From the marriage of Soviet ideology and the military monopoly, it follows that their military industrial establishment can hardly be expected to undertake major space initiatives of a wholly scientific nature.

Another reason for a military concern with Soviet space efforts is that while their programs outstripped those of the United States, there had also been a decided chill in cooperative ventures. Following ASTP, the United States and the Soviet Union continued discussions about future space cooperation. A number of projects were considered, including sending an American shuttle mission to a Russian Salyut station. In October 1976, the two countries held discussions identifying what each country's space capabilities would be in the 1980s. (Unlike ASTP, in which scientific objectives were secondary to docking the two spaceships in orbit, these discussions concluded that prior to selection of hardware for flying cooperative missions, specific scientific objectives should be identified.)[12] In May 1977, NASA and the Soviet Academy of Sciences signed an interagency agreement providing for continuing space cooperation. Since this signing, however, little has been accomplished in formalizing any future space cooperation.

The Soviet Union relies heavily on space systems for many of the same purposes that the United States does. (Weather, navigation, communications, early warning, and reconnaissance satellites are in both near-earth and geosynchronous orbit.) In addition to their important reconnaissance role, these systems greatly assist Soviet leaders by providing near real-time surveillance and over-the-horizon targeting data.

The Soviets also have experimented with offensive strategic systems in space.[13] Although their "fractional orbital bombardment system (FOBS) has been quiet since 1971," the Soviet Union has actively pursued other space programs that could promote a strategic advantage.[14] They have an operational antisatellite (ASAT) system capable of destroying many US satellites. Although these ASATs are presently capable of threatening only near-earth-orbit satellites, the ASAT system in the United States is still in development and not expected to be operational before 1985.[15] Not only will the Soviet ASAT system have matured by that time, it may score an additional propaganda victory by placing an antisatellite laser in space during this decade.[16]

Assessing Soviet intentions based on developmental activities is difficult but necessary if the United States is to avoid a technological surprise. Additional evidence of Soviet intentions to exploit operationally the strategic advantage of space-based weapons is contained in several seemingly unrelated areas: their experimentation with directed energy weapons, their extensive manned space station efforts, their development of a large space booster and a reusable orbiting vehicle, and their concentration on improving a space power generation ability.

Soviet experimentation with directed energy weapons is an ongoing program. In July 1980 *Aviation Week* reported, "from a variety of sources the US has discovered a massive Soviet effort to develop and deploy directed-energy weapons—both high-energy lasers and charged particle beams. There is evidence the Soviets already may have issued orders

to design bureaus to begin prototyping the electron-beam device at Saryshagan."[17] In discussing possible laser battle stations, Clarence Robinson reported six months later, "US intelligence estimates have concluded that the USSR is moving at a pace that could permit it to place high-energy lasers in space between 1984 and 1986."[18]

Another area of active Soviet military space development is manned platforms. In 1971 the Soviets launched an experimental manned space station called Salyut-1, three years prior to the first US experimental Skylab spacecraft. Since that time, they have had nearly 30 manned orbital missions, one of which set a new 185-day endurance record. "The Russians continue to predict they soon will be ready for permanent occupancy of space and will increase station capacity to ten or twenty cosmonauts."[19] Even more definitively, the

> Soviet Union is developing a 220,000-lb. military/ scientific space station to be manned permanently in earth orbit by about 12 cosmonauts. . . . Military objectives are expected to dominate the multidisciplinary station and could include photo and electronic intelligence and the first large-scale development of space-based, directed-energy weapons.[20]

In order to launch their large space platforms into orbit, the Russians have been developing a 10 to 14-million-pound thrust booster.[21] Current work on this giant new booster, comparable to the 7.5-million-pound Saturn-5 booster used in the US moon shots, could result in a launch attempt as early as 1984. If all should go well for the Russians, a large space station launch could be established by 1985.

With progress similar to that in the giant booster development, the Soviets are dramatically improving their space electrical power generation capabilities, primarily as a result of continued nuclear reactor progress. "Loss of the Cosmos 954 reactor powered spacecraft over Canada ... has not slowed the Soviet reactor program."[22] Soviet nuclear reactor developments in space could have important consequences for the advancement of spaceborne laser devices that require high-energy power sources.

Although caution should be exercised in ascribing goals to the Soviets that are not in their long-range policies, the combination of large booster payloads and 12-man space stations with intrinsic electrical power capabilities leads to the conclusion that laser battle stations will be a reality. With only four laser battle stations in space, *Aviation Week* reports the Soviets could "shoot down our entire fleet of high altitude bombers—B–52s, FB–111s and most KC–135 tankers."[23] In addition, Senator Malcolm Wallop suggests that Russian space-based lasers could prevent US flight tests of any missile, or the placing of US payloads in orbit.[24] The possibility that the USSR might be able to prevent the United States access to space presents DOD with awesome responsibilities in the years to come.

PERSPECTIVE ON PARTICIPANTS

Space has been used by the United States for civilian projects with emphasis on scientific exploration, practical applications, national prestige, and international cooperation. So far NASA has led these projects with the involvement of 18 separate US Government agencies (see figure 1–1). By necessity, however, the United States also has a growing space

Arms Control and Disarmament Agency
Department of Agriculture
Department of Commerce
- National Oceanic and Atmospheric Administration
- National Bureau of Standards
- National Telecommunications and Information Administration
- Maritime Administration
- Bureau of the Census

Department of Energy
Department of Health, Education and Welfare
Department of Interior
Department of State
Department of Transportation
- Coast Guard
- Federal Aviation Administration

Environmental Protection Agency
Federal Communications Agency
International Communications Agency
National Science Foundation
Smithsonian Institution

Figure 1–1. Federal Agencies with Civilian Space Activities

effort in support of national security, and DOD will be the most extensive user of the shuttle—the prime space system for the 1980s and beyond. The key to the past and future use of space lies, therefore, in the approved policies for the civilian and military communities.

Civilian Future Unclear

While the leaders of NASA play a key role in planning for and proposing new civilian uses of space, others also have influential roles, including the President, his staff advisors, the Office of Management and Budget (OMB), the congressional space committees, and leaders of the scientific community and the aerospace industry. The public has a role as well, for its enthusiasm or apathy determines the nation's interest in any large space effort.

The public image of the civilian space program was bound up with the adventure of man against space and the glamour of lunar landings. The mass media, not NASA, did an excellent job of publicizing the Apollo programs. The civilian space agency has not done well at bringing home to the public the meaning of science and applications efforts and the potential and actual economic benefits of communications, weather, and earth resources satellites. With regard to technological spinoffs from space, NASA has tried to show benefits to medicine, industrial manufacturing, biological sciences, and program management—but with little evident success.

The reduction of space budgets since the mid-1960s (representing approximately 1.0 percent of the Federal budget in 1982, compared to 4.3 percent in 1965) has made the civilian program less controversial while, at the same time, the public has become apathetic. For the President and Congress to approve any new, large project such as a space lab, increased public support and understanding would be needed.

The aerospace industry was a major beneficiary of the expanded space program of the 1960s. In fact, it was essentially a full partner with NASA in the conduct of all major projects.

Today, individual firms differ on what they believe should be the emphasis for future civilian space programs. Those with ongoing projects would, naturally, like to see them continue. New business, however, will go where the big dollars are, and that is in the defense sector.

Space scientists were among the most severe critics of space policy in the 1960s, with their principal complaint being NASA's emphasis on manned flight. In the late 1970s, their concern centered on reduced budgets because of cost problems on the space shuttle development effort. Although in the past other interests have been more important than science in order to get large space projects through the budget process, the circumstances in which the civilian space agency finds itself now make science support crucial. With fiscal constraints, large military budgets, and public apathy existing in NASA's pathway to future growth, the support of the scientific community will be increasingly important. Ironically, the operational shuttle could be the key to this support, with the expectation that scientists may be able to accompany their experiments into space.

On 21, 22, and 23 September 1981, the Subcommittee on Space Science and Applications of the House Committee on Science and Technology held hearings on future space programs and policy. The subcommittee heard testimony from 12 witnesses on four themes: "Space as a Frontier, Earth as a Base," "How the Next Generation of Space Might Come to Pass," "Spinoffs: The Economic Successes We Have Already Seen and What They Mean," and "Pragmatic Thinkers: Planning Today for Future Space Programs."[25] The hearings were on the subject of future space programs in general and not on the two policy bills introduced in the House.

On 28 July 1981, Representative Newt Gingrich and 13 cosponsors introduced the National Space and Aeronautics Policy Act of 1981 (H.R. 4286). This bill was patterned after Senator Harrison Schmitt's bill from the 96th Congress (S. 212—World Information System by 1990, Orbital Civilization by 2000, etc.) but adds a section concerning the government

of space territories, including the circumstances under which a space community would be admitted as a state.

On 28 May 1981, Representative George E. Brown introduced the National Space Policy Act of 1981 (H.R. 3712), which was virtually identical to the bill he introduced in the 96th Congress calling for rapid development of remote-sensing systems and increased international cooperation. All these hearings and bills are a result of congressional frustration which started in the 95th Congress with the lack of specific goals in President Carter's Presidential Directives (PD) 37 and 42.

Hearings in the second session of the 97th Congress may not have the fervor of those in the past, given the publication of President Reagan's space policy in the summer of 1982. Regardless, the apparent avid interest by Congress in the future of the civilian space program was blunted in the fiscal year 1982 budget process. President Reagan requested a $600 million reduction from that planned by the Carter administration. Congress appropriated only $5.932 billion (table 1–1), which effectively cut the Reagan planned budget by an additional $190 million. Similarly, NASA requested $6.613 billion for fiscal year 1983 ($664 million below the Carter plan). It would appear that the elected officials on the Hill are reflecting the general mood of the public toward the civilian space program—apathy.

In the 1960s the Executive Office of the President contained three major units concerned with space policy: the Bureau of the Budget (which became OMB in the Nixon administration), the President's Scientific Advisory Committee (PSAC), and the National Aeronautics Space Council (NASC). The later two were abolished, although the head of OSTP has now assumed the President's scientific advisor role in place of the PSAC. President Carter set up the Presidential Review Committee (PRC) (Space) within the NSC for rapid referral of policy issues to him—pointing out the obvious mistake of abolishing the NASC. Nonetheless, President Reagan disestablished the PRC (Space) so that now, in the early

Table 1–1. NASA Budget 1959–1979

Fiscal Year	Appropriation	1967 Dollars	GNP Deflator Factor
1959	184.3	214.9	0.8575
1960	523.6	598.1	0.8754
1961	964.0	1,088.2	0.8855
1962	1,825.3	2,032.6	0.8980
1963	3,674.1	4,024.2	0.9130
1964	5,100.0	5,505.8	0.9263
1965	5,250.0	5,565.6	0.9433
1966	5,175.0	5,341.1	0.9689
1967	4,968.0	4,968.0	1.000
1968	4,588.9	4,429.4	1.036
1969	3,995.3	3,682.3	1.085
1970	3,749.2	3,274.4	1.145
1971	3,312.6	2,751.3	1.204
1972	3,310.1	2,629.2	1.259
1973	3,407.6	2,593.3	1.314
1974	3,039.7	2,142.1	1.419
1975	3,231.2	2,052.8	1.574
1976	3,551.8	2,099.1	1.692
Transition Quarter	932.2	550.9	–
1977	3,819.1	2,130.0	1.793
1978	4,063.7	2,112.1	1.924
1979	4,558.8	2,208.7	2.064
1980	5,243.4	2,348.1	2.233
1981	5,522.7	2,266.2(Estimate)	2.437[1]
1982	5,932.0	–	–
1983	6,612.9[2]	–	–

Notes:

[1]Deflator factor for 1981 is not based on a full year's data and is subject to revision; therefore, the 1967 dollars figure is an estimate.

[2]NASA request (March 1982)

Source: NASA Budget Office

eighties, OMB (which was always more important than the PSAC, the NASC, and the PRC (Space) in shaping recurring space policy) exercises the major influence over the US civilian program.

NASA is presently under OMB instructions to reduce its budget requests for fiscal years 1983–1985, planned under President Carter's already low-level funding plan for the agency, by approximately $2.36 billion. In equivalent buying power, this would amount to just over one-half of what the United States was spending yearly in the mid-1960s.

Presidential support is crucial to the future of the civilian space program. Without Presidential support, there is little NASA can do to push new programs through OMB and Congress. President Eisenhower was generally passive and restrained with regard to providing leadership for a vigorous space effort (except to veto any large manned effort). President Kennedy provided bold leadership that set the course of the space program for nearly a full decade, giving President Johnson little opportunity to demonstrate new initiatives, especially with difficult foreign and domestic problems. President Nixon inherited these problems while riding the glory days of the moon landings and did not endorse the space shuttle until it was politically advantageous to do so at the beginning of the 1972 election campaign. President Carter wanted no spectaculars but kept the shuttle development alive at the expense of science and applications funding.

Generalizations on Presidential behavior toward the civilian space program can be risky, given the relatively few years and small number of Presidents involved. Yet, given this progression, an expectation of vigorous leadership for the civilian space program, barring another Sputnik crisis, seems questionable.

Consistent fiscal funding from Congress for any program is dependent on sound policies and goals in the executive branch and a concerted advocacy role played by the agency in charge of the program. The fact that NASA leaders in the mid-1960s did not propose post-Apollo goals to the NASC and

defend them in the budget process virtually ensured a situation in which there was no clear future for the civilian space program. The proposition that NASA leaders are the primary resource for pressing future goals and missions remains true today.

NASA leadership's course, attempted rather unsuccessfully for the last 10 years, has been a balanced program of manned and unmanned flight, with emphasis on science, applications, and international programs. Unfortunately, NASA and most of its prime contractors are heavily oriented toward large space technology development programs like Apollo and the shuttle.

With the shuttle development program winding down, there will be considerable pressure from the mainstream NASA and industry leadership to commit to another large-scale program. Some possibilities include a large manned orbital space station, a large lift vehicle that could place 200,000 pounds of payload into orbit (compared to 65,000 for the shuttle), and a manned space tug designed to let men fly from the shuttle to high-energy orbits for satellite servicing or recovery. Obviously, pursuit of such a program would be incompatible with the funding projected for NASA over the next few years. In addition, it would raise the scientific community's ire just at the time it is expecting a bigger share of the total NASA budget.

There are at least three other pressures facing NASA which affect potential policies to adopt and goals to pursue. The National and Aeronautical Space Act (NAS Act) of 1958 calls for the United States to be "a" leader in space science and technology, not "the" leader. The act also, in the view of most observers, limits NASA to space research, which begs the question of who should operate the shuttle. Does NASA need so many centers to support its reduced space work in the years ahead?

Military Space Program Motivations

There are several determinants in making new space policy for DOD:

1. Bilateral and multilateral treaties and agreements (OST, ABM, etc.)
2. Relevant national policy statements (PD 37 and PD 42)
3. Civil space activities
4. Soviet space activities and technological projections
5. Military use of space and service doctrine

With respect to Soviet space activities, the Russians have continued their high launch rate to 1981, indicating an expansion of capabilities. They attempted 100 launches, compared to 89 each in 1979 and 1980, and placed 124 payloads into orbit—exceeding the previous record of 118 in 1978. Development continued on new boosters, one like the giant US Saturn 5, and on large permanently manned space stations and complexes.

A significant feature of the Russian program and one that has considerable military potential, in addition to their operational ASAT system, is their manned program. Consisting of a space station and a space station module, this program had a great deal of activity in 1981.

Salyut 6, a 42,000-pound space station, completed four years in orbit on 29 September 1981 and remains in orbit in mid-1983. Two cosmonauts performed a 75-day mission beginning on 12 March 1981 and were visited by two more missions, one with a Mongolian and the other with a Romanian crew member aboard. Another launch routinely provided supplies, repair parts, and propellants to the space station.

On 19 June 1981, the Soviets docked Cosmos 1267 to Salyut 6, an event described as a test of rendezvous, docking, and subsequent dynamics involving two large space stations. Cosmos 1267-type vehicles will be used in the future as space station modules, each carrying equipment required for a particular mission. These events certainly portend the advent of a new modular space station and move the Russians well along toward the goal of a large permanently manned space station.

Launches in direct support of Soviet ground, sea, and air forces were also evident in 1981. Seven separate earth resources photography missions were accomplished. Eleven communications satellites were launched, three of which went into geostationary orbit. Another satellite was launched to provide television broadcasts to Far East regions. Meteorological satellite networks were maintained with three launches, and finally, the Soviets expanded earth resources data collection capabilities with oceanographic satellites to collect and relay buoy data from the seas.

The Soviets have often stated their goal of technological superiority. Certain critical military technologies, including electronics, propulsion, materials, and life sciences, received their highest priority in 1981. Over the past 10 years, the Soviet Union is estimated to have taken the lead in the development of directed energy weapons, such as high-powered lasers, and possibly in radio frequency devices.[26] Russia is also thought to have enlarged its lead in electrical power sources for such directed energy weapons.

The Soviet high-energy laser program is not only the world's largest but three to five times the US level of effort.[27] Their knowledge of radio frequency weapons and their development of very high peak power microwave generators give rise to suspicions of possible weapon intent in this area. Since the mid-1960s, the Soviets have been actively pursuing the development of all the high-energy laser types considered most promising for future weapons applications, such as the gas dynamic laser, the electric discharge laser, and the chemical laser.

The trends and momentum of the Soviet space and high-technology programs for 1981, as for the last two decades, reflect a commitment to develop capabilities that enhance and project military power.

With respect to the present and near future use of space by DOD, Dr. Richard DeLauer, Under Secretary of Defense Research and Engineering (USDR&E), spelled out the $8.5

billion (table 1–2) program for the Senate Space Committee on 18 March 1982:

> Space activities of the Department of Defense are continuing to expand, maintaining the trend of the past few years. Our military forces are becoming increasingly dependent upon space capabilities for communications, navigation, weather, and surveillance. As a result of space-based capabilities, we find our forces are becoming more effective in achieving their assigned tasks. To insure that our space assets can support our military forces in the event of war, we are improving the survivability of future space systems.[28]

In the area of military satellite communications (MILSATCOM), the United States presently relies on the Air Force Satellite Communications (AFSATCOM) system and the Navy's Fleet Satellite Communications (FLTSATCOM) system. These SATCOMs are UHF systems with only modest antijam capabilities. These series of polar and geostationary orbit satellites are being upgraded by the high-capacity, super high-frequency Defense Satellite Communications System (DSCS). Increased jam resistance is achieved through improved modulation techniques and the use of higher frequencies; survivability against attack is enhanced through proliferation. The DSCS is designed to meet the needs of the Worldwide Military Command and Control System (WWMCCS), the national command authorities (NCA), the ground mobile forces (GMF), the Diplomatic Telecommunications System (DTS), the Defense Communications System (DCS), and selected allies through the 1980s.

To get through the 1990s and beyond, DOD intends to rely on the successful development of MILSTAR, a highly survivable and enduring SATCOM system designed to provide high-capacity, worldwide, jam resistant communications for all strategic and tactical forces. With a constellation of eight satellites (five geosynchronous and three polar) in orbit, the MILSTAR will incorporate both electronic and physical survivability features. Space-based laser communications also

Table 1-2. DOD Space-Related Funding

Program	Appropriation FY 80	FY 81	FY 82	FY 83
Missions Oriented				
Navigation	185.6	215.4	224.5	291.3
Communications	506.2	625.3	979.7	1,352.2
Warning	207.3	277.3	563.2	714.1
Mapping/Charting/ Geodesy	10.3	11.2	29.2	53.1
Weather	67.9	90.9	114.3	235.9
Vehicle Department	661.0	696.5	863.8	1,110.4
Space Ground Support	242.3	307.4	433.4	557.6
Supporting R&D	427.7	554.0	755.2	972.5
General Support	1,540.1	1,891.2	2,399.0	3,164.6
Total	3,848.4	4,669.2	6,362.3	8,451.7

Note: Figures shown are in millions of dollars.
Sources: Congressional Research Service (March 1982) and, for FY 82 request data, the testimony of Dr. R. DeLauer, USDR&E, before the Senate Subcommittee on Science, Technology, and Space, 18 March 1982.

holds promise for the future. A joint Defense Advanced Research Projects Agency (DARPA) and Navy submarine laser communications (SLC) program is developing blue-green laser light technology for communicating from space with submarines at operational depths, creating minimal impact on the submarine's natural covertness and flexibility.

In the area of navigation, DOD is continuing development of the NAVSTAR Global Positioning System (GPS), expected to be operational by 1988. In addition to its primary function of improving military forces' weapon delivery and target destruction capabilities on a 24-hour, global basis under all weather and visibility conditions, the GPS will also carry the integrated operational nuclear detection system (IONDS) payloads. IONDS will provide real-time strike and damage assessment information, thereby enhancing strategic force management.

In the area of weather, DOD is continuing to support the Defense Meteorological Satellite Program (DMSP). The DMSP's operational requirements dictate the use of at least two satellites continuously in orbit, obtaining weather information from all points on the earth a minimum of four times each day. Regional weather data are also transmitted in real time to key locations supporting Army, Navy and Air Force tactical operations.

In the area of surveillance, DOD is supporting the Air Force's Defense Support Program (DSP) and the Navy's Integrated Tactical Surveillance System (ITSS). The DSP is one of the key elements of the US defense posture and uses satellites at synchronous orbit. In addition to procurement of two more DSP satellites in 1983, the DSP is developing the IONDS for the GPS program. The ITSS program is at present in the concept formulation phase and is exploring whether there is a need for development of an active space-based sensor. Passive sensors (e.g., electro-optical) do not provide worldwide, all weather, day-night surveillance. At the present time, some type of active sensor is felt to be essential and can potentially satisfy more than one military service.

In the area of advanced technology, DOD has several efforts planned or underway. Programs related to missile surveillance technology are developing sensors and collecting data for improved application of infrared (IR) technology. Under the DSP, IR data on earth backgrounds and rocket engine blumes will provide a major contribution to new system design considerations for a space-based missile surveillance system.

Technology development continues for components and concepts for a space-based radar, including transceiver modules, large lightweight phased array antenna structures, and onboard signal processing components. Advanced microwave technology on miniature, low-cost radar transceiver modules using integrated circuit technology is being pursued. The low cost, low weight, and high efficiency of these modules are key factors in feasibility for use in space-borne radars.

In the area of advanced plans, DOD is working with NASA in the definition of requirements for a space station (as yet neither requested by the executive branch nor approved by Congress). DOD is withholding its support until it has examined the potential utility and cost effectiveness of a space station to satisfy national security needs.

NASA and DOD are also investigating launch vehicle concepts to supplement the space shuttle, which may not be able to meet all future demands for space transportation. One concept under consideration is the SRB–X, which uses one or three solid rocket boosters, plus upper stages, to orbit up to 100,000 pounds.

The Air Force is also initiating an Advanced Military Spaceflight Capability (AMSC) program. According to the *Air Force Times*, the "Air Force wants to invest $180 million through FY '88 to analyze and develop the technologies required to put advanced vehicles and systems into space before the year 2000."[29] As military data from space become more essential, the requirement for a responsive launch capability has become critical. Under the AMSC program, quick reaction launch, survivable launch, and aerodynamic space vehicles (reusable from conventional airfields) are concepts to be studied.

DOD conducted a major review of the potential of space-based laser weapons and documented its findings in a 15 May 1981 report to Congress. DOD concluded that space-based lasers offer military potential in a number of applications, but their ultimate utility is beyond DOD's ability to predict. Under a program specifically appropriated by Congress, DOD will begin a $50 million per year (in addition to basic research in lasers) program to aggressively pursue resolution of uncertainties. DARPA and the Air Force are tasked with the job.

Service doctrine originated in the early months of the Kennedy administration. On 16 March 1961, Secretary of Defense Robert McNamara promulgated DOD Directive 5160.32,

Development of Space Systems, which gave the Air Force responsibility for developing, producing, and deploying military space systems associated with surveillance and warning of enemy nuclear delivery capability and all launch vehicles, including launch and orbital support operations. DOD Directive 5160.32 was modified on 8 September 1970 to allow for the assignment of program management responsibilities on a case-by-case basis to other services but require Air Force coordination on their execution.[30]

Over the years the Air Force has attempted to formalize its de facto executive agent role. In the mid–1970s, when neither DOD Directive 5100.1 nor JCS Publication 2 mentioned space (both are formal mission statements for the Air Force), the USAF published its first attempt at a space doctrine. Generally speaking, military doctrine is considered a body of principles, accepted as authoritative, and used to implement national or DOD policy. Air Force Manual (AFM) 1–1, *USAF Basic Doctrine*, dated 15 January 1975, simply reiterated the essence of national space policy:

> *The Space Environment.* The underlying goal of the United States national space policy is that the medium of space must be preserved for peaceful use for the benefit of all mankind. Air Force principles relating to space operations are consistent with this national commitment. National policies and international treaties restrict the use of space for employment of weapons of mass destruction. There is, however, a need to insure that no other nation gains a strategic military advantage through the exploitation of the space environment.[31]

Space operations in this old AFM 1–1 were covered in many of the tasks and subtasks of other more classic Air Force missions, such as strategic defense, surveillance, and reconnaissance.

Two years later the Air Force Chief of Staff stated the USAF role as follows:

> The Air Force affirms that among its prime responsibilities are activities in space related to the development

of weapons systems, military operations, or the defense of the United States, conducted in accordance with national policy and international law.

The Air Force affirms that its responsibilities in space include the duty to protect the free use of space by providing needed peace defense capabilities.

As DOD executive agent for liaison with NASA, the Air Force affirms its responsibilities for close coordination and cooperation on projects of mutual interest.[32]

Following publication of PDs 37 and 42 in 1978, the Air Force republished AFM 1–1, with a slightly different title, and included space operations as one of its nine basic missions, i.e., strategic aerospace offense, space operations, strategic aerospace defense, airlift, close air support, air interdiction, counterair operations, surveillance and reconnaissance, and special operations.[33] Within the space operations mission, this AFM 1–1 lists three tasks—space support, enhancement, and defense. There are no subtasks under space defense, but the other two contain four each. Under space support are listed launch and recovery, on-orbit support, satellite surveillance, and satellite control operations. Under space enhancement are listed global surveillance, communications, navigation, and meteorological operations.

These space operations are explained in greater detail in AFM 1–6, *Aerospace Doctrine, Military Space Operations* (published 15 October 1982). Designed to be a basic statement of the current Air Force beliefs concerning space operations doctrine, one of the early draft versions addressed future space activities:

This growing importance of space operations introduces the eventual possibility of offensive space-to-space and space-to-earth warfare. However, the United States intends to deter the introduction of offensive military capabilities into space by whatever means are appropriate.[34]

In summary, all of the major factors deemed important in developing new space policy for DOD, except one, seem

committed to the peaceful use of space. Bilateral and multilateral treaties and agreements, relevant national policy statements, civil space activities, and the US military use of space and service doctrine are all opposed to weapons in space, especially offensive weapons. Only Soviet space activities, along with their corresponding technological projections, are headed in another direction. The United States is not prepared for this eventuality, and the solution to the problem lies in policy and organizational changes for both NASA and DOD.

2. THE EVOLUTION OF THE US SPACE ORGANIZATION

In December 1981, the Government Printing Office released the President's report of aeronautics and space activities for calendar year 1980.[1] This 103-page, nearly half-inch thick document chronicles the seemingly vast accomplishments of seven Government departments (Defense, Commerce, Energy, Interior, Agriculture, Transportation, and State), plus the Federal Communications Commission (FCC), Environmental Protection Agency (EPA), National Science Foundation (NSF), Smithsonian Institution, International Communication Agency, and NASA. By addressing some 45 space efforts, satellite programs, various studies and research, etc., the impression is that the national space program, with over two decades of activity under its belt, is on firm ground and pursuing concrete goals for the future.

In truth, questions and issues still abound. President Carter published military and civilian space policy statements (June 1978 and October 1978, respectively) that were subsequently criticized because specific goals and programs were not identified. (See appendix B for texts of these directives.) Congress showed its frustration. Four bills were introduced in the 96th Congress offering alternatives to the President's policies, and hearings were held in both the Senate and House. Legislation was reintroduced in the 97th Congress.

What will the new policies be? Will they meet the same fate as President Carter's? Is the US public interested in a commitment to exploring and exploiting space? Is the National Aeronautical and Space Act of 1958 adequate as a policy ve-

hicle for the 1980s and beyond? As the DOD budget and military dependency on space systems increase, what is the perceived threat versus international agreements?

Answers to these questions and substantive comments on the issues, to be meaningful for the future, have to come from past experiences and the knowledge gained from them. In search of insight, therefore, the next section traces the complicated and confusing evolution of the US space program through past administrations, beginning with the Eisenhower years.

THE EISENHOWER CONSTRAINTS

To state with certainty the beginning of the space age would be difficult. But, if you were to ask a significant number of people, a majority would surely reply "Sputnik"—meaning, of course, Sputnik 1 launched by the Soviet Union on 4 October 1957. The USSR quickly followed this space first with two more launches: the 1,120-pound Sputnik 2 on 3 November with a live dog onboard and the 2,925-pound Sputnik 3 on 15 May 1958, described as a complete laboratory. Unaccustomed at being second best at anything, the US public was shocked and questioned not only the status of the nation's space technology but also the political process that allowed such surprises (and what they meant in terms of military security).

The relative capabilities of the United States and the Soviet Union at this time were predetermined over a decade earlier by differing military emphases. Following World War II, the United States was complacent, resting on its overwhelming dominance in manned bombers and advanced nuclear bomb technology. With the sole exceptions of Dr. von Braun's team of ex-German missile experts established by the Army at White Sands, New Mexico, to rebuild and test fire some captured V–2 missiles and the establishment of the low priority Navy-Viking high-altitude research rocket program, there was not much else in the late forties that could be called a serious American space effort.[2] The American military had decided to

concentrate on the existing manned aircraft fleet capability to deliver its nuclear might and not actively pursue the development of an intercontinental ballistic missile (ICBM).

The Soviets took a different path following World War II, however, having essentially no air power and lagging miserably behind the United States in nuclear warhead technology. Instead of trying to match the advanced bomber fleet of the Americans, they decided to develop the enormous rocket boosters required to carry their heavy nuclear bombs over intercontinental ranges.

By the early fifties, utilizing two ballistic missile facilities and knowledge gained from captured German scientists, the Russians were reported to be developing a rocket engine with a thrust of 260,000 pounds. Between mid-1953 and late 1956, the Soviets effectively set the stage for the infamous Missile Gap.

By their test of the hydrogen bomb on 12 August 1953, the Russians informed an astonished world that they had mastered this facet of high technology. In the summer of 1955 they were routinely testing an intermediate range ballistic missile (IRBM) capable of hitting targets 1,000 miles away in Western Europe, and by the fall of 1956, they had begun testing a longer range ICBM.

The beginning of the US reappraisal of the ICBM's potential as a long-range strategic weapon came in May of 1951. (The USAF had let a modestly funded ICBM study contract to Convair, now a division of the General Dynamics Corporation, in January 1951.)[3] It was the results of laboratory tests by the Atomic Energy Commission (AEC) that indicated the basic feasibility of constructing an H-bomb.

Before the ICBM could be a viable strategic weapon, however, major problems had to be addressed, such as more accurate guidance systems, more powerful rocket engines, and smaller warheads with the technology to enable the warheads to withstand the turbulent, searing heat of atmospheric reentry at hypersonic speeds. The AEC continued its

efforts for over two years before announcing the thermonuclear breakthrough in the summer of 1953.[4] Laboratory experiments indicated that the size and weight of the H-bomb could be reduced drastically, permitting a much smaller ICBM.

The coincidence of this breakthrough with the Russian H-bomb test caused a frantic scurry of activity in the United States. All three military services vied for the leadership role in development of the ICBM, and the Pentagon established the Strategic Missiles Evaluation Committee (more popularly known as the Teapot Committee), composed of distinguished scientists, to investigate the future of ICBMs given this technological advancement.

Meeting for the first time in November 1953, the Teapot Committee submitted its report in February 1954. It urged a massive effort that would secure an effective ICBM as soon as possible, because the nation was in mortal danger and only a quantum jump could prevent disaster in the 1959–60 time period.[5]

By virtue of the von Braun team, the Army was well ahead of the other services in missile development. In fact, by August 1953 they had fired the Redstone, the first US liquid propellant long-range (200 miles) missile.[6] The Navy had been working with the Army on an advanced Redstone called Jupiter but dropped out later in favor of developing the easier-to-handle solid propellant rockets for submarine applications. Despite this, the USAF became the lead military service, and within three months of the Teapot Committee report it had given its highest priority to the General Dynamics study effort which later became the Atlas ICBM program.

Even with the scientific community's warning and the USAF's eagerness, support of the Eisenhower administration would not come for over two years. In the summer of 1955, a US intelligence radar near the Black Sea began to track the Russian IRBM launches. The Soviet missile progress was so disturbing that the National Security Council (NSC) recommended that the USAF Atlas development effort be given the highest priority in the nation. In its deliberations, the NSC

felt the Soviets were pulling abreast of the United States in long-range jet bombers and that it was likely a Russian ICBM could be developed as much as two years earlier than the USAF's. If true, the military foreign policy of Massive Retaliation would be stripped of its deterrent value and, even more ominous, the nation would lie exposed to the possibility of a "thermonuclear Pearl Harbor."[7]

In September 1955, President Eisenhower agreed with the NSC and gave the development of the Atlas ICBM the nation's highest priority. Since much work remained on the Atlas, the administration hedged its bets by also authorizing development of the Titan ICBM (by the Martin Marietta Corporation), which could carry a larger payload over greater distances. The administration's authorizations did not stop there.

In a bold effort to counter the approaching Missile Gap, on 15 November 1955 two IRBM developments were approved with a priority equal to the Atlas and Titan programs, but with the proviso that they not interfere in any way. To hold the fort until the ICBMs could be deployed, the IRBMs could be quickly placed in Western Europe where their 1,500-mile range would be sufficient to reach parts of the Soviet Union. Douglas Aircraft was selected to develop the Thor, and the Army Ballistic Missile Agency (ABMA), under Dr. von Braun, was authorized to design and build an improved Redstone IRBM (called Jupiter).

Some statistics will illustrate the magnitude of the Air Force's total missile program.[8] Within three years, it was approaching an annual cost of $2 billion and was utilizing the services of almost 14,000 scientists and technical experts from universities and industry, as well as 1,500 USAF administrative officers. Also participating were an additional 76,000 people representing 22 industries, including 25 major prime contractors and 200 major subcontractors.

While 1955 was the year that saw the race to close the Missile Gap officially start, it was also the year that heralded the beginning of another race with Russia in connection with

the International Geophysical Year (IGY). The designated period from 1 July 1957 through 31 December 1958 was established by an international organization of scientists, for the IGY, as a period for intensive study of the earth and its environment. One of the experiments included in the broad spectrum of IGY activities planned by the scientists was to be the launching of artificial satellites.

By the early 1950s, based on the Navy's successful upper atmosphere research program using the post-World War II developed Viking "sounding rockets," scientists knew the orbiting of small, instrumented satellites was no longer a question of feasibility—but how to get Government support for the necessary launchers and facilities?[9] The National Academy of Sciences (NAS) and the NSF began their role of lobbying the Eisenhower administration early in 1955. President Eisenhower's personal interest was achieved, and in an effort to announce America's plans for the IGY before Russia released its own plan, Press Secretary James Hagerty released the following statement on 29 July 1955.

> On behalf of the President, I am now announcing that the President has approved plans by this country for going ahead with the launching of small Earth-circling satellites as part of the United States participation in the International Geophysical Year. . . . This program will for the first time in history enable scientists throughout the world to make sustained observations in the regions beyond the earth's atmosphere.
>
> The President expressed personal gratification that the American program will provide scientists of all nations this important and unique opportunity for the advancement of science.[10]

The USSR made a similar announcement the following day, and a Russian physicist declared that their launches would be much larger than anything the United States would attempt.

The US Government had three choices for satellite launchers in the fall of 1955: the USAF's Atlas ICBM, the ABMA's Jupiter-C IRBM, or an entirely new launch vehicle

based on the Viking sounding rocket technology. It was at this point that President Eisenhower's philosophy of wanting to present an image to the world of the United States fostering the peaceful uses of space was born.

Although the Soviets made no distinction between military and IGY launch systems, and despite Dr. von Braun's belief that the Jupiter could be readied for a satellite launch by as early as September 1956, the administration chose the high-risk third option as most appropriate for the civilian character of the IGY's scientific efforts. Thus, with the formation of a team from the nearly completed Viking program, Project Vanguard was initiated and the race for space was on. Scientific jurisdiction was to come under the NAS. Funding was to come from the NSF, and further, instructions were received that Vanguard could not interfere with any defense related programs.

For the next two years, the Vanguard project made faltering progress, plagued as it was by the tension of the space race, seemingly endless trials to achieve a viable launcher, and inexperienced contractors. Following the humiliation of Sputniks 1 and 2 and loss of the race, it was clear that at least part of the explanation was President Eisenhower's insistence that any US satellite launched in support of the IGY be identified as a nonmilitary program.

In October 1957, following Sputnik 1, the President insisted that Vanguard be used to launch the first US satellite, and he gave that project highest priority. Continuing reliability and quality problems, coupled with the Soviet's successful 3 November launch of Sputnik 2, led to the President's authorization five days later for launch of a satellite using the existing Jupiter military rocket plus a solid propellant fourth stage, which gave the carrier the new name Juno.[11] This was indeed a fortuitous decision, for on 6 December 1957 the first Vanguard launch was an embarrassing failure when the vehicle lifted about four feet from the pad and then fell back in flames. Besides being witnessed by the largest group of reporters and

observers ever assembled for a launch, the crowning blow came from the Russians when they offered to aid the United States through their United Nations plan to provide technical assistance to backward nations!

Some semblance of technological equality was restored when, courtesy of the Army's ABMA and the Juno rocket, the 17.6-pound Explorer 1 satellite was launched on 31 January 1958. America had not only reached orbit but discovered the Van Allen radiation belts, undoubtedly the single most important scientific achievement of the IGY. Vanguard finally made its first successful orbital flight on 17 March 1958, carrying a 4.4-pound satellite, leading to the discovery that the earth is slightly pear-shaped. This was not the beginning of an immediate success story for Vanguard, however; the next four launch attempts ended in failures, and it would not be until nearly a year later (17 February 1959) that a 22-pound satellite was in orbit again.

The problems associated with Vanguard were a manifestation of the Eisenhower administration's policies toward science and research in general. One noted author, Donald Cox, pointed out that the cults of "Complacency, Bureaucracy, and Omnipotence" were at work.[12] Another, Jerry Grey, said that Vanguard was plagued by the necessity to operate an ultra-advanced technology program on a minimal "shoestring" basis.[13] Indeed, with respect to nondefense expenditures, the administration was inclined to hold the line, especially in research and development. Science agencies, both military and civilian, generally felt their budgets were too low to keep pace with the fast changes in technology.

The President personally viewed the IGY satellite launches as a limited project in international scientific cooperation and any follow-on space projects as unnecessary. His convictions were not altered by Sputnik 1 or the announcement three days later by the Soviet Union that it had tested a new H-bomb at high altitude. (Shock waves were felt in Japan.) At a 9 October 1957 press conference, President Eisenhower sought to play down the importance of the Rus-

sian accomplishments by saying they did not increase his apprehensions "by one iota."[14]

The President's existing policies and remarks during October failed to quiet the press, the Congress, and the public. The news media questioned the policy of putting domestic budgetary and political considerations ahead of national security. Senator Stuart Symington called for a full investigation, and Senator Lyndon Johnson, chairman of the Preparedness Investigating Subcommittee of the Senate Armed Services Committee, announced plans for a prompt investigation of why the Russians had beaten the United States in launching a satellite.

These series of hearings during October 1957 confirmed the nation's lagging status in both satellite and missile programs and laid the groundwork for the eventual major role that Congress would play in the national space program.[15] The launching of Sputnik 2 within a month of Russia's first space spectacular, along with the fact that it was six times as heavy and of much more sophistication, caused the public's apprehension about the nation's lagging scientific and military prowess to change into anxiety. These events effectively combined to force the President's hand.

Two days following Sputnik 2, President Eisenhower picked Dr. James R. Killian, president of the Massachusetts Institute of Technology, to be his Science Advisor. Announced in a speech on 7 November 1957, the new position granted important institutional access to the White House by the scientific community. However, it would be 4 February 1958 before Dr. Killian had acquired the task of setting up the mechanism for managing a national space program.[16] The latter months of 1957 and the early part of 1958 were a period of confusion and competition throughout the executive branch. Both the military services and the civilian science agencies actively vied for management of the space role. Possibilities centered on the following:

First, a single agency for all Government programs managed by the military, either at the Secretary of Defense level or by one of the armed services, most likely the Air Force;

Second, a new Cabinet-level Department of Science and Technology which, among its other responsibilities, would have charge of the civilian space effort;

Third, space added to the responsibilities of the Atomic Energy Commission;

Fourth, the responsibilities of the National Advisory Committee on Aeronautics (NACA) expanded to include a substantial component of space activities; and

Fifth, a new civilian agency with a responsibility for Government space activities, except those primarily associated with defense applications (which would be managed by DOD).[17]

As these possibilities became clearer over the winter months through the lobbying efforts of various executive agencies, so were the strong preferences of the Eisenhower administration. They were in favor of (a) a civilian agency to handle all aspects of research and development with scientists playing an important role in guiding the space effort, (b) an agency subject to the direct control of the President as opposed to the NSF or AEC which had strong aspects of independence, and (c) a new agency built upon the basis of an existing agency.

Shortly after Sputnik 2, almost coincident with the approval for the Army to launch the Juno rocket, President Eisenhower gave responsibility for the US space program to DOD, owner and manager of all the nation's existing space capability. In February 1958, Congress authorized DOD to establish the Advanced Research Projects Agency (ARPA). Within a month, that agency's interim plan for space exploration was approved by the President. Thus in a genuine sense, the first US space agency was a military organization, ARPA. This role for the military was to be short-lived, however, because the image it portrayed was in direct conflict with the 8 October 1957 American request to the United Nations General Assembly that "outer space be brought under international

control and be used only for scientific and peaceful purposes."[18]

Bills in Congress proliferated as champions of various agencies sought to secure new scientific and space-related functions for favored agencies. Included were bills to turn space over to the AEC and the NSF, as well as totally new agencies, one to be called the Commission on Outer Space. Another new entity was proposed in two bills to be called the Department of Science, an umbrella for science, parts of which would cover space. Even more comprehensive were bills proposing a new Department of Science and Technology which would subsume existing agencies, such as the NSF, the AEC, the NACA, and the Bureau of Standards.[19] For the hearings on these bills, and eventually the administration's proposal, the Congress was well prepared.

In addition to the hearings in the fall of 1957 were hearings by both the Senate and House Appropriations Committees, the House Armed Services Committee, and the Special Subcommittee on Outer Space Propulsion of the Joint Committee on Atomic Energy. In February 1958, the Senate established a Special Committee on Space and Astronautics, chaired by Majority Leader Lyndon Johnson, and in March the House created the Select Committee on Astronautics and Space exploration, chaired by Majority Leader John McCormack, (D-Mass.).

It should be noted that these committees were subsequently changed to standing committees to oversee the space budget. They were titled Aeronautical and Space Sciences (Senate) and Science and Astronautics (House). These stayed in existence until Congress reorganized its committee structure in 1976–77. The Senate committee was eliminated altogether and its space budget cognizance transferred to a subcommittee of the Commerce Committee, but the House committee, which continually expanded its scope over the years, became the powerful Committee on Science and Technology.[20] (For the sake of simplicity, Senate or House *space committee* will be used in the remainder of this work.)

During this period of intense congressional activity, the administration was working hard on its own legislative proposal. In early February 1958, President Eisenhower asked Dr. Killian to formulate a plan leading to an adequate civil space agency. Working in conjunction with experts in administrative organization, such as William Finn of the Bureau of the Budget, it soon became clear that Dr. Killian favored turning the space responsibilities over to NACA; it most closely paralleled the agency envisioned by the President. NACA had proposed adding *Astronautics* to its title (becoming NACAA) and picking up the space role in January 1958. The Science Policy Research Division of the Congressional Research Service quotes Arthur L. Levine's account of the NACA plan.[21]

> The leaders of NACA were among those diligently and rapidly working on the preparation of a proposal for the assignment of the space role. Their first step followed the traditional lines of NACA procedure as they established a special committee on space technology, headed by H. Guyford Stever, Associate Dean of Engineering at MIT. This was on 21 November 1957. Less than two months later, the Main Committee of NACA adopted a resolution recommending that the national space program could be most effectively implemented by a cooperative effort of the Department of Defense, the NACA, the National Academy of Sciences, and the National Science Foundation, together with universities, research institutions and industrial firms. Under the NACA plan, the military would be in charge of development, construction and launching of space vehicles, while the NACA would have responsibility for research on satellites and scientific experiments in space.

This was a simple solution for the NACA, since it merely elaborated on its over 40 years of experience and existing procedures. Leadership would continue by an executive board or committee, and activities would be limited primarily to research with other responsibilities divided among various Government agencies, especially the military.

While acknowledging that the skills and facilities of the NACA in aeronautics were without equal, Dr. Killian and the

administration had problems with the "NACAA" plan. During its history the NACA had shown itself to be rather refractory to political leadership, much like the AEC and the NSF; i.e., its independent committee structure did not tie directly to the President. In addition, NACA tradition had established its character, an academic or research orientation, a trait considered too narrow for a major new space agency.

The administration's solution to these problems became evident when President Eisenhower sent a Special Message to Congress on Space Science and Exploration wherein he outlined his proposal to established NASA. The aforementioned bills before Congress and hearings that had been underway for months became academic when the administration's legislative proposal was actually introduced on 14 April 1958.

Rather than a simple enlargement of the old aeronautical research group, the administration proposed establishing an entirely new organization, with NACA as its nucleus, to be endowed with powerful operating authority. The new agency would have a single executive who would be responsible to the President but aided by a 17-man statutory advisory board. In addition, it would have the authority to contract for systems development and procurement of hardware, to eventually launch satellites and other space vehicles, and to immediately acquire other existing Government agencies that could aid the space program.

Reflecting the President's views on the civilian nature of future space endeavors, the legislative proposal left the NASA–DOD relationship vague with no formal coordination dictated. In fact, the administration never envisioned a joint civil-military space program. The President's Scientific Advisory Committee (PSAC), set up in late 1957 and headed by Dr. Killian, advised that to do so would violate President Eisenhower's personal philosophy and jeopardize the US initiative to reserve space for scientific and peaceful purposes.

Just as the administration had problems with the "NACAA" plan, Congress had similar misgivings about the

President's NASA proposal. For a period of over two months, each house of Congress wrestled with its version of the NAS Act. A conference committee met for nearly a month to resolve the differences which centered on "organizational structure, status of NASA in the Executive Branch, and the NASA-military relationship."[22]

The House's concern with Government and DOD membership on the 17-man Advisory Space Board was rather quickly disposed of by the conference committee. It struck the provision for the board from the bill and simply stated the new Administrator of NASA would be a civilian with wide operational powers.

The Senate had recommended establishing a seven-member Space Policy Board, operating from the Executive Office of the President, to include the NASA Director, the Chairman of the AEC, the Secretaries of Defense and State, plus three others appointed by the President. The conference committee amended the recommendation to include the President as the eighth member and chairman. Its name became the National Aeronautics and Space Council (NASC), from which Congress expected that major space policy would emanate.

Sensing the nation's need for a totally responsive, comprehensive approach to space, both the Senate and House committees experienced difficulty with the informal NASA-military relationship proposed in the administration bill. No doubt the Russian launch of the 1½-ton Sputnik 3 on 15 May 1958 was an influence, as evidenced by the language of House Resolution 1770, dated nine days later:

> ... this country is not unmindful of what these Soviet achievements (in space) mean in terms of military defense.... Ballistic missiles already travel for a considerable part of their path through near outer space and can arrive virtually without warning to deliver their devastating thermonuclear warheads. The United States must have strong capability in the use of outer space, both as a deterrent to the use of military vehicles against this country and as an aid in developing antimissile techniques. Satel-

> lite (operations) will have important implications for guarding the peace. On one hand they are adjuncts to weapon systems related to the deterrent power, and on the other they represent important techniques for inspection and policing, in accordance with any disarmament scheme which may be negotiated in the years to come.[23]

Clearly Congress envisioned a role for the military in space. The Senate committee carefully defined the jurisdictions of NASA and DOD, then placed coordination authority in its proposed Space Policy Board. The House committee version simply established a military liaison committee consisting of personnel from DOD. The conference committee chose the House concept. Called the Civilian-Military Liaison Committee, it would have broad powers to coordinate NASA and DOD activities and consist of equal membership from each agency.

The conference committee's version of the NAS Act was accepted without debate or amendment by both houses on 16 July 1958. Thirteen days later, President Eisenhower signed the NAS Act of 1958 (Public Law 85–568), establishing NASA and abolishing NACA as of 1 October 1958. Section 102(b) of the NAS Act dictated the dual space program responsibilities which exist today.

> The Congress declares that the general welfare and security of the United States require that adequate provision be made for aeronautical and space activities. The Congress further declares that such activities shall be the responsibility of, and shall be directed by, a civilian agency exercising control over aeronautical and space activities sponsored by the United States, except that activities peculiar to or primarily associated with the development of weapons systems, military operations, or the defense of the United States (including research and development necessary to make effective provision for the defense of the United States) shall be the responsibility of, and shall be directed by, the Department of Defense....

Thus, an administration for space was established, including a mechanism for adjudicating possible conflicts between NASA and DOD via the Civilian-Military Liaison Committee and a

method for forming total space policy via the National Aeronautics and Space Council with the President as Chairman.

Thomas K. Glennan came to NASA from the presidency of Cleveland's Case Institute of Technology. After confirmation by the full Senate, Mr. Glennan was sworn in on 19 August 1958 as the first Administrator of NASA.

The tenure of Mr. Glennan, through the remainder of the Eisenhower Presidency, was hectic as he attempted to amalgamate the diverse programs, personnel, and facilities transferred into NASA. From the former NACA, NASA inherited 8,000 employees and five research centers. The centers included the Langley Laboratory (now Langley Research Center) at Langley Air Force Base, Virginia, which studied aircraft and missile structures, and the Ames Aeronautical Laboratory (now Ames Research Center) at Moffett Naval Air Station, California, which studied the problems of high-speed flight. It also included the Lewis Flight Propulsion Laboratory (now Lewis Research Center) at Cleveland, Ohio, which worked on engines for airplanes and spaceships; the High Speed Flight Station (now Dryden Flight Research Center) at Edwards Air Force Base, California, where experiments with manned rockets were underway; and the Pilotless Aircraft Research Station (now Wallops Flight Center) at Wallops Island, Virginia, which tested rocket-powered vehicles.[24]

In November 1958, NASA acquired the Naval Research Laboratory and Project Vanguard and approved their move to the Goddard Space Flight Center, which was to be built on Government land near Greenbelt, Maryland. In December 1958, two Army programs were transferred to NASA: the ABMA's launch vehicle program, under Dr. von Braun, at the Redstone Arsenal (now Marshall Space Flight Center) in Huntsville, Alabama, and the Explorer satellite program at the Jet Propulsion Laboratory in Pasadena, California.

With this rich inheritance of scientists and facilities, NASA's space research was able to begin at once. As part of its broad development program aimed at furthering the un-

manned exploration of space, NASA sent three rockets loaded with instruments deep into space, put three new satellites into orbit, and conducted advanced tests on rockets and satellites. Despite these feats, the nation's hoped for leap-frogging of the Soviet space accomplishments was not Mr. Glennan's legacy to his successor in the Kennedy administration. In fact, NASA's launch record during the 29 months under Glennan's leadership shows only eight successes in 25 attempts.

While NASA may have been less than spectacular in space, it certainly became a capable and functioning Government agency. With the help of his deputy and long-time leader in NACA, Dr. Hugh Dryden, as well as a prestigious management consulting firm, Mr. Glennan succeeded in pulling NASA together during a period of organizational evolution, a period of reassignment of personnel, a period of realignment of subgroups, and a period of structuring both internal and external relationships. Reliability programs, long-range planning, and executive training became established functions. Finally, the nation's industrial and university sectors were successfully coupled with NASA's goals and requirements.

With NASA's absorption of the major Army and Navy space capabilities, the Air Force and the ARPA moved ahead with the DOD space program. On 11 October 1958, an Air Force Thor-Able launch vehicle lifted the Pioneer I space probe nearly 71,000 miles toward the moon in the deepest penetration of space achieved by man up to that time. Two months later, on 18 December, an Air Force Atlas B put the ARPA's SCORE, the first communications satellite, into orbit. For 13 days it broadcasted President Eisenhower's Christmas and New Year's greetings to the world.

By the end of the Eisenhower administration, the Air Force accomplished several other space firsts, thanks to its recognized stable of efficient, reliable space launch vehicles, and its $2 billion per year IRBM and ICBM programs. Out of more than 40 successful launches came the first satellite placed in polar orbit, the first photographs of the earth taken

from space, the first meteorological satellite, and the first ocean and midair capsule recoveries.[25]

Nearly all of these efforts, however, were programs in which NASA held the lead role. In the majority of cases, with the exception of reconnaissance, the military requirement for a space program could not be pushed through or justified. As a result, NASA's unmanned, purely scientific missions proliferated while the Air Force played mostly a support role.

In summary, the national space program started midway through President Eisenhower's second term but was clearly constrained. Neither the jolt of the Sputniks nor subsequent Soviet space achievements (in 1959, Lunik 2 landed on and took pictures of the backside of the moon, and in 1960, Russia orbited and recovered space capsules carrying live dogs, as well as a 14,300-pound operational satellite) convinced the administration that a major national space undertaking was called for.

President Eisenhower preferred that NASA, though endowed with considerable powers by Congress, dedicate itself primarily to scientific activities and proceed at a measured pace. Since the Russian accomplishments, each more spectacular than its predecessor, did not pose a threat to national security in the administration's view, a "space race" solely for the sake of prestige was not deemed necessary.

The NAS Act's inclusion of the concept of a single civilian-military space program, with the NASC as the mechanism to achieve an integrated policy, was never endorsed by President Eisenhower. Instead, the President preferred to consult with his Scientific Advisor and the PSAC, which consistently disapproved early DOD and NASA plans for advanced manned space flight programs, including a proposal for an American expedition to the moon, because of insufficient scientific or military justification for such undertakings.

Therefore, the nation's first space policy (a framework for which many exciting possibilities existed under the new Space Act), as practiced by the Eisenhower administration, can be

characterized as conservative, cautious, and constrained. Those who were to take charge of the development of space policy in the next administration would have a different view.

KENNEDY'S MOON RACE

While the enactment of the NAS Act of 1958 moved the nation toward a space policy, the development of a full-fledged policy did not come to fruition until several months after President Kennedy assumed office. The key elements of the Space Act—a primarily civilian program; a coordination of civilian and military space efforts; a multipurpose space program, to include but not be limited to science and applications; a strong commitment to international cooperation—saw their initial, forceful implementation under President Kennedy's leadership. Even though President Eisenhower was instrumental in assuring these elements (with the exception of the concept of an integrated civilian-military program) were inserted into the act, he did comparatively little to establish them as fixed features of space policy.

Space activity under President Eisenhower was akin to a series of separate and unrelated efforts. NASA conducted interesting experiments in weather and communication satellites and in space science, along with a limited manned project called Mercury. Meanwhile, the Air Force was conducting programs in reconnaissance satellites, communications, and rocket research. Though each had specialized programs producing specific capabilities in a narrow range, there was no overall capability being developed to operate in space for either civilian or military purposes.

In 1960, there were two manifestations of this problem: when President Eisenhower asked Congress to abolish the NASC and when NASA and DOD established the Aeronautics and Astronautics Coordinating Board (AACB). President Eisenhower never accepted the idea of a single civil-military space program and felt that the statutory concept of the NASC enforcing the program from a national policy viewpoint was not only "confusing, but unattainable."[26] This attempt to abol-

ish the council was successfully blocked by Lyndon Johnson who argued that the action might restrict the freedom and options available to the next President. Establishment of the AACB by interagency agreement was driven by the ineffectiveness of the Civilian/Military Liaison Committee and the need for lower level coordination between NASA and DOD. In fact, the liaison committee would finally be abolished in 1965, and the AACB continue to function into the early eighties.

The poor launch record of NASA and the impact of Soviet space achievements entered into the 1960 Presidential campaign. Combined with the concern over the military position of the United States in missile power, America's chances for leading in the space race made for a significant campaign issue on technology. Controversy over whether there were missile gaps or space gaps marked the campaign. While Kennedy warned of peril to the national defense unless policies were changed, Nixon argued that the gaps were more imaginary than real.

President-elect Kennedy decided in January 1961 that Vice President Johnson would have special responsibilities for coordinating and overseeing US space efforts. His first task was to recommend a new NASA Administrator to replace Mr. Glennan, whose resignation was effective at the close of the Eisenhower administration.

Johnson wasted little time in selecting James E. Webb over several outstanding "technical" nominees. By formal education a teacher and lawyer whose forte was administration and whose natural element was high technology and aerospace in particular, Mr. Webb had served as Director of the Bureau of Budget from 1946 to 1949 and then moved to Under Secretary of State for three more years. Within 10 days of being nominated by President Kennedy on 30 January 1961, the Space Committee had enthusiastically endorsed and the full Senate had confirmed Mr. Webb. Destined to preside over NASA during its period of maximum growth and capability, he was sworn in on 14 February 1961.

The second task entrusted to Vice President Johnson was longer term and more important. President Kennedy obtained legislation to reactivate and restructure the NASC with the Vice President as its Chairman. Thus, the Senate's "Father of the NAS Act" and later defender of the NASC's continued existence under Eisenhower became the Council's Chairman and the curator of the nation's civil-military space policy.

Many observers believed that the NASC would become active immediately after the inauguration, but such was not the case. For the first two months of the new administration, President Kennedy was deeply involved in his first crisis, the decision of whether or not to intervene with US troops in Laos where the pro-American Government of Phoumie Nosavan seemed near military defeat by the Communist Pathet Lao forces.[27] It was not until late March that the President turned his personal attention toward space policy by nominating Dr. Edward C. Welsh to be Executive Secretary of the Space Council.

Dr. Welsh's first task was to draft revisions of the NAS Act to reactivate the Space Council. Completed in less than two weeks, his two recommendations, in addition to the President's desire to make the Vice President a member and chairman, were simply aimed at giving the Council greater flexibility and at clarifying its organizational status in the administration.

The former was achieved by elimination of the four appointed members of the Council, thus reducing its membership to five: the Vice President, the Secretaries of State and Defense, the Administrator of NASA, and the Chairman of the AEC. The latter change placed the council in the Executive Office of the President. These recommendations were approved by the President and sent to Congress on 10 April. The House held hearings on the revisions on 12 April, the Senate on 19 April. Congress passed them on 20 April and the President signed them into law on 25 April.[28]

Quick congressional approval was almost assured by the Soviet space spectacular of 12 April. The world's first space ship, Vostok 1, with Major Yuri Gagarin onboard, was launched from Russia on an 89 minute, single orbit flight around the earth.[29] The 5-ton spacecraft was totally automatic, and Major Gagarin suffered no apparent problems. Soviet propaganda was quick and stressed that the flight was evidence of the virtues of victorious socialism and of the global superiority of the USSR in all aspects of science and technology. No high US official had predicted such an event; the general public received it with almost as much shock as it had experienced for the Sputnik 1 flight of 1957. Oversea and domestic news media hailed this additional Soviet first.

Congress, in addition to considering the NASC proposal, was in the midst of hearings on President Kennedy's supplemental request to add to Eisenhower's fiscal year 1962 budget. The hearings were extremely vocal, especially in the House, because the NASA portion of the supplemental, while requesting an increase, contained no specific plans for a follow-on manned program after the limited series of Mercury flights.

Right in the middle of this activity came the Bay of Pigs incident. Begun on 15 April, the invasion was crushed in only four days. On 20 April, coincident with congressional approval of the revised Space Act empowering Vice President Johnson to be Chairman of the NASC, President Kennedy wrote a historic memorandum to Johnson.

> ... I would like for you as Chairman of the Space Council to be in charge of making an overall survey of where we stand in space.
>
> 1. Do we have a chance of beating the Soviets by putting a laboratory in space, or by a trip around the moon, or by a rocket to land on the moon, or by a rocket to go to the moon and back with a man. Is there any other space program which promises dramatic results in which we could win?
>
> 2. How much additional would it cost?

3. Are we working 24 hours a day on existing programs? If not, will you make recommendations to me as to how work can be speeded up.

4. In building large boosters should we put our emphasis on nuclear, chemical, or liquid fuel, or a combination of these three?

5. Are we making maximum effort? Are we achieving necessary results?

I have asked Jim Webb, Dr. Wiesner, Secretary McNamara and other responsible officials to cooperate with you fully. I would appreciate a report on this at the earliest possible moment.[30]

Facing a 9 May departure for a 15-day tour of Southeast Asia, the Vice President did not have much time to prepare an answer for the President. During the days following the 20 April memorandum, the Vice President met with officials from the NASA, the DOD, the AEC, the Bureau of the Budget, and Dr. Wiesner's office. (Dr. Wiesner was the President's Science Advisor and head of the PSAC.) At no time during these consultations was PSAC asked for its opinion, a significant departure from the Eisenhower administration's modus operandi. Vice President Johnson also met with prominent businessmen and personal friends in the Senate to get a feel for possible public reaction to a major increase in the nation's space efforts.

One event helped ensure that an accelerated space program would be accepted by the President and the country. On 5 May Astronaut Alan Shepard made the first American space flight, a 15-minute suborbital journey in the "Freedom 7" Mercury capsule. This success climaxed a long period of difficulties for Project Mercury. With over 500 representatives of the news media present at Cape Canaveral to report America's first manned flight, it was unlikely that the President would have, or could have, endorsed an expanded space program had it not been such an unqualified success, both technically and politically. As the *New York Times* reported on 6 May,

President Kennedy planned to undertake "a substantially larger effort in space."

By this time the NASC discussions had agreed that a program setting a manned lunar landing as its central feature would be a sufficiently difficult goal, and its achievement before the Russians would repair the US image and restore confidence in American technological superiority. In essence this was NASA's Apollo Program disapproved by Eisenhower in 1960. In addition to the acceleration of all areas of booster development (liquid fuel and nuclear propulsion by NASA and solid fuel by DOD) and the more rapid development of communications and meteorological satellites, the total program encompassed the following:

First, completion of the Mercury Program of suborbital and earth orbital flights;

Second, initiation of the Gemini Program of Earth orbital flights for developing skills in rendezvous and docking between two ships, developing expertise in extravehicular activity, and extending knowledge of man's space endurance; and

Third, commencement of the Apollo Program, following Gemini, to first achieve orbit and then land Americans on the moon.

The program was outlined in a memorandum, prepared by Secretary McNamara and Mr. Webb, for the Vice President to give to President Kennedy. Receiving the memorandum the day before he was to leave on his tour, Vice President Johnson accepted it without change and signed it to the President.

Several days of debate ensued within the White House staff and the President's Council of Economic Advisors. Ultimately the program was totally accepted and on 25 May, three weeks after Alan Shepard became the first American in space, President Kennedy addressed a joint session of Congress.

> ... I believe that this nation should commit itself to achieving the goal, before this decade is out, of landing a

> man on the moon and returning him safely to earth. No single space project in this period will be more impressive to mankind, or more important for the long-range exploration of space; and none will be so difficult or expensive to accomplish.... In a very real sense, it will not be one man going to the moon—we make this judgment affirmatively—it will be an entire nation.

Congress and the nation were willing to make the commitment. Space goals for the next decade were set and the moon race was on. Prestige and international leadership were clearly the main objectives of the Kennedy space program. Science and applications were important but secondary. While not an overt objective, military security was obviously involved, since the ability to reach the moon with men was indirectly an index of the technical capability to wage nuclear war with missiles.

The status and power with which NASA had been endowed in the Space Act could now be used to accomplish this challenge, and Congress was ready to provide generous funding. The Apollo project was the chief beneficiary, but science, advanced technology, and applications programs were also given the go-ahead for expansion. During fiscal year 1962, NASA budgeted $110 million in geophysics and astronomy, $160 million in lunar and planetary exploration, $36 million in nuclear technology research, and $145 million for communications and meteorological satellites. In comparison, manned spacecraft systems and the supporting launch vehicle work accounted for $1.269 billion. That was just the beginning, however, for ultimately the Mercury program would cost $392 million, the Gemini program $1.3 billion, and the Apollo lunar program $25 billion.[31]

While NASA concentrated on the manned lunar landing program and its other scientific programs, DOD moved along with its activities in space. Some of these were similar to NASA's programs, such as meteorology, communications, and reconnaissance satellites (especially earth resources satellites with substantially better resolution limits). The importance of intelligence gathering and its impact on DOD's space efforts cannot be overemphasized. This subject is treated ex-

pertly, especially with respect to the role played by early reconnaissance satellites in the Cuban missile crisis, in a National War College research paper by Colonel Fred H. Wisely, USAF.[32]

The development of ballistic missiles was, in a very real sense, an integral part of the story of the DOD in space, since the missiles provided the vital initial launch capability. The Western Development Division (redesignated the Ballistic Missile Division in 1958) of the Air Research and Development Command (ARDC) had been developing the nation's stable of IRBMs and ICBMs since 1955. It was, in fact, not until just before President Kennedy's moon race speech to Congress that the military space effort became a separate and distinct program in its own right.

On 1 April 1961, in a major Air Force reorganization, the parallel Ballistic Systems and Space Systems Divisions were created, under the Deputy Commander for Aerospace Systems of the newly formed Air Force Systems Command (AFSC). A little more than 10 months after the Space Systems Division came into being, a man-rated Air Force Atlas D boosted the first US manned orbital mission in the Mercury program. Astronaut John Glenn in the Friendship 7 was safely recovered after three orbits and 4.9 hours in space. Three other successful manned flights followed in the next 15 months, all Atlas boosted, before the program concluded with the Mercury-Atlas 9 flight of 15 May 1963. For NASA's follow-on Gemini program, the Air Force's powerful Titan II was chosen to boost the two-man capsules.

The DOD even dabbled with the idea of its own manned space program. The X–15 rocket-plane program, started jointly by NACA and the Air Force in 1956 to explore the characteristics of flight in near-earth space, was the only one to reach fruition, however. It completed 199 flights between 1959 and 1969. The Air Force's Man In Space Soonest program was cancelled soon after NASA's limited project Mercury was approved under Eisenhower. The X–20 Dyna-Soar program, a joint Air Force-NACA effort started in 1957, would have devel-

oped a space glider capable of maneuverable reentry from orbit. The program was cancelled in 1963 before any test flights were made, because the Air Force decided to focus instead on the "Blue" Gemini and Manned Orbiting Laboratory (MOL) programs. Blue Gemini would have been the Air Force extension of NASA's manned Gemini program to demonstrate rendezvous and docking in space, extravehicular activity, and relatively long duration flight. These Air Force plans were also cancelled in 1963, because Congress saw no need for such a capability. Similarly, the MOL program, which would have placed a military manned space station in near-earth orbit, was eventually cancelled in 1969.

In summary, through 1960 Government and university scientists (with the sympathetic ear of the PSAC), the military, and the aerospace industry had been the dominant influences in shaping space research policy. President Eisenhower exercised veto power over the launching of a large military space program or a large-scale civilian manned program, but the White House had no positive space policy in terms of specific goals formulated on its own or in conjunction with NASA leadership.

However, under President Kennedy, the old triumvirate of interests had to share its power with a dynamic and new Administrator of NASA, the congressional committees, and to some extent the appropriation subcommittees with jurisdiction over NASA. The flight of Yuri Gagarin, the Bay of Pigs incident, and the first manned flight of Project Mercury may have spurred President Kennedy. But it was largely JFK's personal and decisive participation in policymaking that gave the nation a clear space policy with management by a strong civilian agency, with a firm goal, and with strong direction expected to continue from the top of the Government.

THE JOHNSON ADVOCACY

President Kennedy did not live to see even the preliminary steps toward the lunar landing, but there was little fear

that the pace of the space effort would be slackened under Lyndon Johnson as President. LBJ had, after all, been the "Father of the Space Act," and in his abbreviated first term (November 1963–January 1965) there was no lessening of his steadfast support of the space program.

President Johnson did not only pursue JFK's balanced program concerned with international prestige, international relations, and the building up of US technology but also sought an "across-the-board capability" by injecting a series of other goal values—technological achievement, scientific discoveries, commercial applications, domestic political benefits, economic stimulus, and military insurance.[33] With this impetus during LBJ's first term, NASA enjoyed a meteoric rise in budget and personnel, and the Air Force and NASA logged many space firsts.

The Air Force completed the long meticulous job of man rating the powerful Titan II booster and successfully tested it in two initial unmanned flights that were preparation for the first two-manned Gemini flight in March 1965. Meanwhile, the Atlas-Agena, Thor-Agena, and Scout boosters continued to launch dozens of other projects in support of NASA and DOD. They included the Ranger moon probe series; the Tiros series of meteorological satellites; the Mariner Venus probes; Alouette, Canada's first satellite for gathering ionospheric data; and Anna 1B and the Transit series for the Navy. They also included Discoverer for ARPA, to return US payloads from space; Vela I and II, nuclear detection satellites that lasted years past their predicted useful lifespan; Echo, a passive communications satellite and the first joint space project with the Soviets; and other communications satellites, one of which (Syncom III) relayed television coverage of the Olympic games from Japan to the United States.

The manned portion of the Gemini program, probably the brightest and most publicized single project in the United States space effort, coincided with the start of LBJ's second term and marked the permanent downturn in NASA's fiscal budgets. In 19 months of 1965 and 1966, 10 flights, carrying a

total of 20 men, were launched by Air Force Titan IIs and had a 100 percent safety record. The astronauts walked in space and explored the difficulties of working there. They rendezvoused with Air Force Agena D targets, parked in orbit by Atlas SLV-3 launch systems. They docked with the target vehicles and, using their propulsion systems, soared to two world's record altitudes of 470 and 850 miles. The end of the program came with the four-day flight of Gemini 12, beginning on 11 November 1966, when Air Force Astronaut Major Edwin Aldrin, Jr., set a world's record for extravehicular activity, remaining outside the spacecraft for a total of 5½ hours.

The combination of social problems at home, the escalation of the Vietnam war, and inflationary pressures (for which the antidote adopted by the Government was reduction in certain areas of Federal spending) caused President Johnson in his second term to reassess his estimate of the relative priority of the space program as compared with other national needs.

The depth of the difficulties for the NASA program is shown by his decision to reduce NASA budgets by substantial amounts. For example, for fiscal year 1967 LBJ requested $163 million less for NASA than had been appropriated for the previous fiscal year.[34] For fiscal year 1969 President Johnson, beset by Vietnam and domestic troubles, slashed the NASA budget request (submitted in January 1968) to $219 million below the appropriation for fiscal year 1968, bringing the space agency budget request down to $4.37 billion. Compared to the heyday of the Gemini program in 1965, this represented nearly a $1 billion cut.

Congressional reaction to these budget cuts was swift and usually more severe (the budget appropriations are shown in table 1-1 and are graphed in figure 2-1). The mood of Congress is clearly illustrated; in fact, if funding of an agency is used as a barometer to gauge congressional interest or general public support, it would appear that in the eight years following Sputnik, there was indeed a space race. However, taking the final step of getting a man on the moon (Apollo),

once the spectacular Gemini program had started, would not appear to be of great congressional interest. Obviously, as the interest in Congress waned rapidly in the mid-1960s, no amount of world acclaim or scientific return could reawaken it.

Manpower in the civilian space program, in terms of total employment (figure 2–2), almost duplicates the shape of the funding curve. Beneath the total employment curve in figure 2–2 a NASA personnel line has been plotted. (See table 1–1 for the actual numbers.) It should be noted that employment and funding (in terms of buying power) declined rapidly to the previous 1962 levels after peaking in the 1965–1967 time-frame and remained relatively constant through the Carter administration.

Relatively speaking, funds for Apollo were not heavily cut due to LBJ's perceived need to keep the lunar landing project on schedule. This was no easy task for several reasons. As the reductions came each fiscal year, Mr. Webb exercised his flexibility in the research and development (R&D) account by reducing planned scientific projects and slipping the Apollo Applications Program (later renamed Skylab) to the out years.

The scientific community and the PSAC were chagrined, for they had questioned the Apollo program for years on the basis of its total cost, its drain on the technical and scientific manpower needed for other national objectives, and its necessity for man to accomplish a job that robot instruments could do at a slower pace and at less cost. The pace of the Apollo program was also questioned in light of the military security it was ensuring when the Treaty on the Peaceful Uses of Outer Space, the Moon and Other Celestial Bodies was signed in October 1967 and in light of later indications that Russia may have relinquished its bid to be the first nation to set foot on the moon. Finally, and tragically, there was an actual 1½-year delay in the Apollo schedule due to a fire on the first spacecraft, which killed the three-man crew by asphyxiation, on 27 January 1967.

Thus, although his Great Society program was troubled by fiscal problems, Vietnam, and domestic unrest, LBJ re-

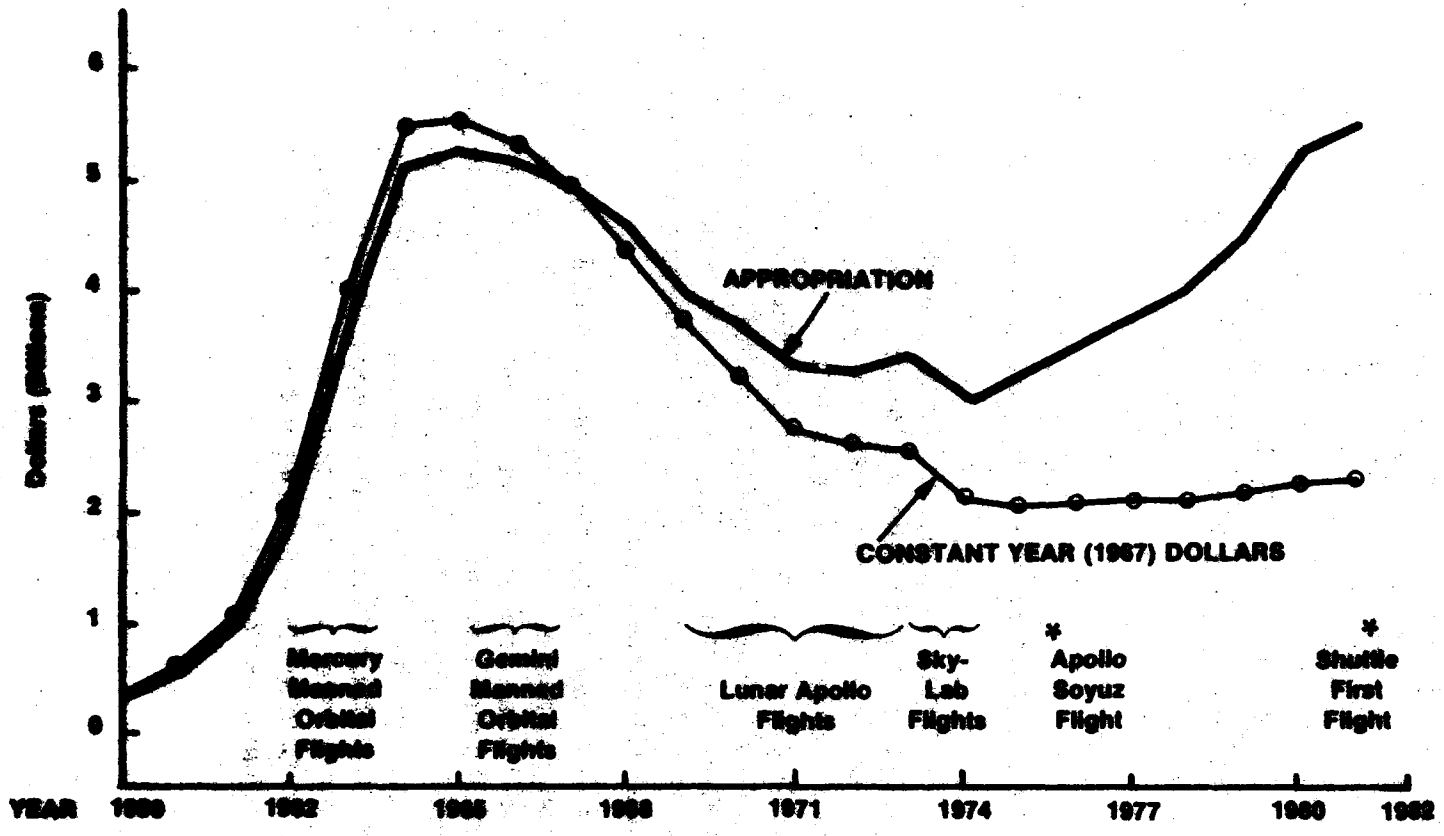

Figure 2–1. NASA Budget Appropriations

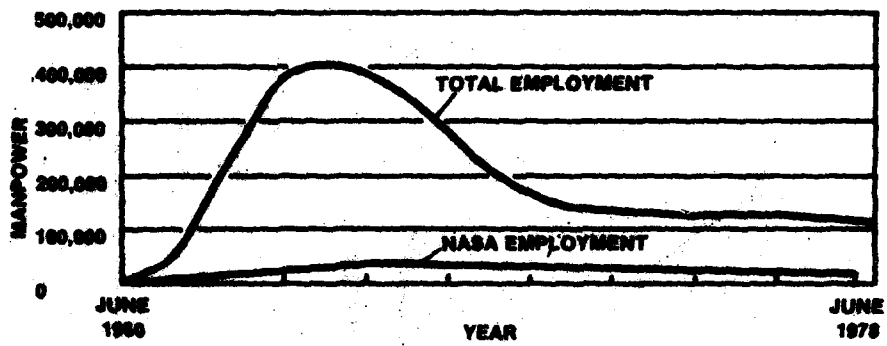

Figure 2–2. Manpower in the Civilian Space Program

mained a strong supporter of space activities, both military and civilian (especially Apollo). He maintained his interest in an across-the-board space effort, including manned and unmanned exploration and development of new propulsion systems. He gave his support to the Air Force plans to orbit the MOL and consistently supported Secretary McNamara's appropriation requests for MOL funding. He remained a strong advocate of NASA's Rover project to develop nuclear rockets for manned planetary flight.

As President Johnson's second term drew to a close, the overriding concern of the National Space Program over the first eight years emerged clearly: the commitment to land a man on the moon and return him safely to earth. With the flight of Apollo 11, the nation accomplished that goal on 20 July 1969, six months into the Nixon administration, when Neil Armstrong and Edwin Aldrin first stepped foot on the moon. All in all, there were 11 manned flights of the lunar Apollo series between October 1968 and December 1972, 6 of which landed two-man crews on the moon.

In summary, despite a multitude of technical problems, a chorus of criticisms from the scientific community, severe budgetary constraints due to urban problems and Vietnam, and the tragic setback of the Apollo spacecraft fire, LBJ persisted in pursuit of President Kennedy's goal. Although these difficulties did not deny achievement of the goal, they did have an impact on space policy in the post-Apollo era. This impact related to the questioning of the necessity of human presence in space exploration, the debate concerning the amount of emphasis that science and applications should receive, and the lack of consensus concerning the direction of the space program of the 1970s.

NIXON-FORD DILEMMA

For personal reasons, Mr. Webb departed from NASA nine months prior to the first lunar landing. He left at a time of high personal standing with both the Johnson administration and Congress, closing an extraordinarily successful eight-year tenure. Over the last few years of his leadership of NASA, Mr. Webb consistently hedged in the formulation of concrete post-Apollo goals, preferring instead to list alternatives over which he felt bureaucratic debate would ensue and a national consensus would emerge. His unexpected departure just prior to the 1968 Presidential election left NASA with great expectations for the forthcoming moon landings but a questionable long-range future.

Dr. Thomas Paine, Mr. Webb's deputy, was appointed Acting Administrator of NASA by President Johnson a few days after Webb's 7 October 1968 resignation. Following President Nixon's nomination, Dr. Paine was confirmed as Administrator on 5 March 1969. Dr. Paine's short administration (through 15 September 1970) was characterized by contrast. The world watched the maturing Apollo spectaculars while the internal prime task was to minimize the rising costs of program deferrals and cancelations. The highlights of the period were rewards from investments made in the past, but NASA had

entered a period in which investments for future events were increasingly austere.

While Apollo 11, the first human visit to the moon, was a historic first, it was also an anticlimax. The event and the landings subsequent to Apollo 11 did not alter the downward trend in funding. The NASA budget declined rapidly between 1966 and 1970, averaging $500 million per year (table 1–1). The number of people employed on space projects declined from 420,000 in 1966 to 190,000 in 1970 (figure 2–2).

In mid-1969 the civilian space program was at a crossroads. The euphoria at NASA produced by Apollo 11 led Dr. Paine to press for endorsement by the nation of new manned space ventures, including a 1980s mission to Mars, the establishment of a base on the moon, and a large (50 to 100 man) orbiting space station serviced by a space shuttle. In addition, an ambitious program of unmanned planetary expeditions, other scientific projects, and applications satellites was proposed.

These recommendations had an obvious impact on President Nixon's Space Task Group (STG) that was charged with conducting a high-level study of post-Apollo activity. Made up of Vice President Spiro Agnew (head of the NASC and Chairman of the STG), Secretary of Defense Melvin Laird, Presidential Science Advisor Lee Dubridge (head of the PSAC), and Dr. Paine, the STG made public in September 1969 three alternatives the nation could undertake:

First, the United States could establish a 50-man space station orbiting the earth, an orbiting lunar space station, a lunar-surface base, and a manned flight to Mars by 1985. A reusable carrier would be needed to "shuttle" between the earth's surface and the earth-orbiting station, and a reusable "space tug" would be needed to service the lunar orbital station.

Second, it could establish the earth-orbiting space station, along with the reusable shuttle, but eliminate the lunar projects and postpone the manned Mars launch to 1986; or

Third, the nation could develop the earth-orbital space station and the shuttle but defer any decision on the manned Mars landing, keeping it only as a goal to be realized before the end of the century.[35]

The first two options carried fiscal price tags in the 1980s of $10 billion and $8 billion, respectively, and option three would still require a $5 billion annual NASA budget in the same timeframe.

President Nixon's position and ultimate policy decision would not come out until March 1970, but its flavor could almost have been predicted. In his 1968 election campaign, President Nixon had pledged to curtail NASA operations until the economy could afford more funding. The Republican's national platform also promised to move civilian space programs "forward with high priority" only once sound fiscal conditions had been restored.[36]

After entering office, as a part of a general anti-inflation, multibillion dollar Government-spending curb, President Nixon slashed the NASA fiscal year 1970 budget request (submitted by President Johnson) by $45 million to $3.772 billion, nearly a quarter of a billion dollars less than the 1969 appropriation. The general interest of Congress towards space was exemplified by its further reduction of NASA's fiscal year 1970 budget to $3.749 billion and its wholesale cancellation of the Air Force's MOL program.

There were other precursors of President Nixon's March 1970 space policy announcement. Critics in the Congress, in the media, and in the American public, generally, decried the magnitude of the space program plans presented in the STG report, to say nothing of the funds necessary to meet the program goals.[37] Although interested in seeing a continuation of large space projects, the aerospace industry was not united as to which specific projects should have priority. While several companies had special interests due to peculiar space capabilities, industry as a whole favored DOD over NASA because of the magnitude of its business with the military.

Finally, Vietnam, the economy, domestic unrest, the state of the welfare program, and other issues commanded more attention than new space ventures. These concerns were reflected in the administration's fiscal year 1971 budget request to Congress submitted in January 1970. NASA's budget was cut to $3.377 billion, $372 million below the fiscal year 1970 appropriation.

Thus, after President Nixon had been in office only one year, NASA was forced to announce several major program changes. In February 1970, the Apollo Applications program was renamed Skylab, and although originally planned to coincide with the lunar landing flights, it was rescheduled to 1973–1974. In addition, instead of seven crews being sent to two space stations, only three crews would be sent to a single space station.[38] NASA also announced that the last lunar landing mission (Apollo 20) was being cancelled, and all preliminary work on a space shuttle and a manned flight to Mars was being put on hold. By September 1970, the Apollo 18 and 19 missions were cancelled too.

The President's long-awaited space policy statement of 7 March 1970 was a carefully considered and carefully worded document that should not have surprised the space community, in light of the activity over the preceding 13 months. It was highly cognizant of political realities and the mood of Congress and the public:

> ... space expenditures must take their proper place within a rigorous system of national priorities.... What we do in space from here on in must become a normal and regular part of our national life and must therefore be planned in conjunction with all of the other undertakings which are also important to us.[39]

While the President's pronouncement did not back new large projects, as proposed by Dr. Paine and the STG, the statement did identify three "general purposes which should guide our space program exploration, scientific knowledge, and practical applications." Clearly, President Nixon considered the space program to be of intermediate priority in 1970, not

justifying increased investment or the initiation of large new efforts, but a vehicle for exploiting and extending the technological and scientific gains which had already been realized.

NASA interpreted the President's statement as endorsement of (a) its reduced manned space activities (remaining Apollo missions, the Skylab program, and a possible joint US-Russian mission in the mid-1970s), (b) its plans for a "Grand Tour" exploration of the planets by unmanned satellites (Mars, Jupiter, Saturn, Uranus, Neptune, and Pluto in the late 1970s), and (c) its expanded programs in the practical applications of space technology (earth resources, meteorology, and communication satellites and greater international cooperation in space).

NASA's fiscal funding spiral did not stop at the $3.377 billion level, however (the budget submitted to Congress in January 1970 for fiscal year 1971). In fact, by December 1970 Congress had passed the fiscal year 1971 appropriation bill which cut an additional $64 million. This pattern would repeat itself through fiscal year 1974 when NASA suffered its lowest budget in over a dozen years ($3.040 billion in absolute or then-year dollars). The corresponding figure in relative buying power, or constant year 1967 dollars, was just over $2 billion and would remain there throughout the decade (table 1–1). Basically, then, the Nixon (and later Ford) dilemma in approaching civilian space efforts was to try to balance the competing claims of budgetary constraints with the need to keep the national program viable, i.e., to curtail without crippling.

The annual attempt to solve the funding dilemma met its biggest test during the election year of 1972. By this time fiscal stringency had caused further project cutbacks, including much of the "Grand Tour." The tour was severely reduced, leaving only unmanned visits to Mars and Jupiter in the Mariner and Pioneer series, respectively. Fiscal constraints also caused a scaling down of the Nuclear Engine for Rocket Vehicle Application (NERVA) program and of a number of projects,

such as the High Energy Astronomy Observatory (HEAO), that were considered of the highest priority by scientists.

It was in this environment that NASA had been studying the concurrent development of the Thrust-Assisted Orbiter System (TAOS, later named the shuttle) and a manned space station. Since such a dual program was estimated to cost $10 billion, which was not economically (and therefore politically) feasible, and since it did not make sense to build the space station without a low-cost supply system (the shuttle), NASA's only logical choice was to seek approval for the TAOS.

President Nixon gave the go-ahead for the shuttle in January 1972 for mainly three reasons:

First, it promised to drastically reduce launching and operational costs through reusable vehicles;

Second, it was a value to DOD. The Air Force had followed the shuttle studies since cancellation of the MOL program but did not give its support until NASA redesigned the cargo bay to accommodate DOD payloads; and

Third, it would employ an additional 40,000 aerospace workers by the mid-1970s, which was important to forecast in an election year.

Even with these important considerations in favor of Presidential endorsement, the OMB urged disapproval. It took a personal appeal from Dr. James Fletcher, the new Administrator of NASA (since April 1971), to gain final approval from President Nixon.

The White House approval got little fanfare, but in the fiscal year 1973 budget approval process Congress nailed down the lid on what NASA had agreed to: a first orbital flight in 1979 at a total development cost of $5.22 billion (in 1972 dollars) and a total program cost, including the development costs, five orbiters, the necessary boosters and tanks, and launch facilities, of $7.5 billion (1972 dollars).[40] The congressional debate also put an absolute limit of 20 percent on cost overruns ($1 billion), which NASA was willing to accept in re-

turn for program approval. Knowing the high level of technological risk inherent in the program, opponents of the shuttle, mainly from the scientific community, accused NASA of "buying in" in order to keep man in space to the detriment of more important scientific endeavors.

By the time that Congress had locked-in the total program costs, NASA still had five technological "nuts-to-crack": (a) to use a liquid propellant booster, recoverable but not flyable, or a totally expendable, inexpensive solid propellant booster; (b) to reduce the design weight of the shuttle without impacting the 65,000-pound payload capability; (c) to develop a new thermal protection system, since the heat shield principles of previous manned systems were inadequate for a reusable shuttle; (d) to design and test new high-performance rocket engines for the orbiter; and (e) to solve the requirement for an onboard, self-contained flight-control system.

Early in the program and before President Nixon left office, for obvious cost and reliability reasons NASA decided to discard both booster options in favor of recoverable solid-propellant rockets, with a giant liquid-fuel tank (expendable) for the shuttle's main engines. The design weight problem was solved by dropping the requirement for jet engines, thus making the orbiter a glider once it reentered the atmosphere.

By the time President Ford completed his term in January 1977, NASA had not solved the heat shield and shuttle rocket engine problems, and OMB had reduced requested funding (over a three-year period) by $274 million. While NASA was able to operate within tight fiscal constraints, the net effect was that very real problems existed, with associated cost increases and schedule slippages in the offing for the next administration.

In summary, the era of space spectaculars for NASA, great enough to interest the entire world, began in 1969 with the first Apollo lunar voyages. Five more flights followed, along with the three very successful Skylab flights, in which three astronauts had lived and worked in a minispace station—with the final mission lasting 84 days. The National

Space Program received its final boost in 1975 with the Russian-American Apollo-Soyuz Test Project, a mutual docking of the two spacecraft in which coupled air locks could be opened as a passageway between the ships.

The worldwide enthusiasm over man's first departures from earth was not shared in Congress, at least not in the form of increased funding. The hopes of some NASA officials for another Apollo-like commitment in the form of a manned expedition to Mars or a huge manned earth-orbital space station or lunar base were quickly dashed. The declining budget and shrinking activity in NASA began prior to 1969 and continued through both administrations.

NASA saw a dramatic increase in practical space applications covering worldwide communication systems, meteorology, earth resource surveys, and scientific stellar and solar observations, as well as military surveillance satellites and navigation systems. Since Congress favored these applications over spectacular lunar and planetary voyages and if the real value of the new domain of space were to mature, then a less costly means of transportation seemed essential. For the then foreseeable future, emphasis shifted from big expendable boosters to development of a versatile "truck" to service near-earth orbits.

CARTER AND NO SPECTACULARS

Although data are difficult to acquire, during the four years of the Carter Presidency, the Russians had in excess of 430 space launches, of which 17 were manned and included Czech, Polish, GDR, Bulgarian, Hungarian, Vietnamese, and Cuban cosmonauts. One mission, Soyuz 32, had a crew duration time in space of 175 days. In addition, the Soviets designed, developed, tested, and deployed an antisatellite (ASAT) system.

By contrast, the United States had only 65 launches (excluding classified DOD efforts). These included four deep space probes, 15 scientific payloads, and 46 applications satellites (8 navigation, 3 earth observation, 11 weather, and 24

communication). As the shuttle development problems started to manifest themselves in terms of schedule slippage, it became obvious that no Americans would be launched into space for the remainder of the decade. With the President's edict for no space spectaculars and maintenance of low-level funding, the space "depression" became firmly entrenched.

Dr. Robert Frosch took over leadership of NASA on 16 June 1977 following Dr. Fletcher's resignation the previous month. His primary task for the next four years was to salvage as much of NASA's scientific and applications efforts as possible in the face of runaway inflation, straight-line budgets, and rising shuttle costs. NASA used several means to minimize the shuttle funding requirements as well as total program costs: it borrowed production funds for the development program; it deferred work to the next fiscal year; it slipped the flight schedule; it eliminated all contingency funds below the headquarters level in order to force managers to be creative in seeking solutions to technical problems within the budget; and it finally cancelled procurement of one orbiter. The cost of the shuttle's four test flights in fiscal year 1982 is now estimated to be $9.9 billion or about 25 percent over the original estimate and is just under two years behind schedule.

In the Nixon administration the NASC was little used after its work on the STG report, and its staff was cut. In 1973, utilizing statutory reorganization powers granted by Congress, President Nixon abolished the Space Council. During President Ford's last year in office, Congress passed the National Science and Technology Policy, Organization, and Priorities Act of 1976 (P.L. 94–282). Under this act, the President's Office of Science and Technology Policy (OSTP) ostensibly provides a broad overview of new technologies being studied throughout the Government. More specifically, the Director of OSTP is the source for scientific and technical analysis and judgment for the President with respect to major policies, plans, and programs of the Federal Government. After taking office, President Carter retained OSTP within the Executive Office of the President, and within 16 months it was to play the dominant role in the formulation of space policy.

Early in the Carter administration, a series of joint studies involving the NSC, DOD, OSTP, and NASA were conducted to address apparent fragmentation and possible redundancy among Government sectors with space activities and to develop a coherent recommendation for national space policy. The product of these efforts matured in the spring and fall of 1978 as the Presidential Directive on National Space Policy (PD 37) and on Civil Space Policy (PD 42).[41]

The emphasis of PD 37, published 20 June 1978, was coherent space principles (increase scientific knowledge, develop technology, maintain leadership, etc.) and did not deal in detail with the long-term objectives of commercial and civil programs. It was not void of specifics, however, the first being the establishment of the NSC Policy Review Committee (PRC) for Space. Chaired by Mr. Frank Press, Director of OSTP, the PRC (Space) provided a forum for all Federal agencies in which to advise on proposed changes to national space policy and also provided rapid referral of issues to the President for decision.

In addition, the OMB was tasked to review all programs to identify duplication, prioritization, and efficiency, and NASA was directed to pay virtually all the costs associated with development of the shuttle (for DOD-peculiar costs see table 2–1). Lastly, DOD was chartered to design survivability into space systems, develop an ASAT capability, and "bump" civilian payloads from scheduled shuttle flights for national security purposes if required.

The heavy emphasis of PD 37 on DOD activity caused much consternation within the civilian space community. Within four months (11 October 1978), President Carter had signed PD 42, US Civil Space Policy. (See the complete White House press releases in appendix B.) Completed by the PRC (Space), PD 42 was a less-aggressive directive for pursuing, in an evolutionary manner, the research, development, and applications of space systems for civilian use in the next dec-

Table 2-1. DOD Shuttle Funding—FY 80 President's Budget Figures

Fiscal Year	Budget
FY 71 and prior	$ 4.3 million
72	3.0
73	3.7
74	3.5
75	10.0
76	18.5
77 + TQ	8.2
78	206.3
79	390.7
80	444.8
81	383.7
82	256.0
83	160.1
84	85.0
Total	$1,9777.8

Note:

Data were supplied by the Air Force, March 1980. This table includes funding for Inertial Upper Stage, preparation of Vandenberg Air Force Base for shuttle operations, and operations capability development.

Figures up to and including FY 80 are actual expenditures; those for FY 81–84 are estimates of funding to completion.

Source: Congressional Research Service (November 1981).

ade. There was much criticism of the vague goals established in PD 42, especially in Congress.

Four bills were introduced in the 96th Congress addressing alternatives to the policy. The two Senate bills (S. 212 and S. 244) were originally introduced by Senators Schmitt and Stevenson, respectively, immediately following the release of PD 42. The bills were reintroduced, with changes, at the beginning of the 96th Congress, and hearings were held in both the Senate and House in January and February 1979 (even though no House bill had been introduced as

yet). On 5 June 1979, Representative Dorman introduced H.R. 4316, which was identical to the original Schmitt bill from the 95th Congress (S. 3599), and on 28 January 1980, Representative George Brown introduced H.R. 6304, which was based on the Stevenson bill.

Although none of the bills was reported from committee, the hearings were spirited and provided for a very broad space policy, with associated programs, for the next 30 years. Provisions included a world information system by 1990, an orbital civilization by 2000, manned exploration of the solar system by 2010, and development of technology to support the three program areas.

The rhetoric of the 96th Congress was symptomatic of the continuing policy debate within various agencies of the executive branch, especially NASA and DOD, through the election year of 1980. President Carter's policy never waivered, however, and is best summarized by the third "tenet" of PD 42:

> It is neither feasible nor necessary at this time to commit the United States to a high-challenge space engineering initiative comparable to Apollo. As the resources and manpower requirements for shuttle development phase down, we will have the flexibility to give greater attention to new space applications and exploration, continue programs at the present levels or contract them.

REAGAN YEARS: STAGE OF TRANSITION

In the first 14 months of the Reagan administration the National Space Program experienced some interesting ups and downs from which it is hard to discern just what direction high-level policy and programs are headed. Simply stated, policy has been drifting, and the United States is experiencing a stage of transition with regard to space.

NASA gained new leadership under President Reagan. Dr. Frosch resigned on 20 January 1981, and his deputy, Dr. Al Lovelace, acted as the Administrator of NASA until the new appointee, James Beggs, severed his business interests and was sworn in on 10 July 1981. On that same day and of more

importance to the military, Dr. Hans Mark, former Secretary of the Air Force in the Carter administration, was sworn in as Deputy Administrator, replacing Dr. Lovelace. Within four months, the Air Force's most successful program manager in the late-1970s, and a fully trained astronaut for the old MOL program, Major General James Abrahamson, was appointed Associate Administrator of NASA for the Space Shuttle Program.

Even though none of the space bills of the 96th Congress was reported out of committee, activity on the Hill was brisk after Mr. Reagan took office. Two more bills (H.R. 3712 and 4286) were introduced in the 97th Congress, dealing with a National Space Policy for the next decade. In addition, in the fall of 1981 hearings were held on future space programs by the Subcommittee on Space Science and Applications of the House Committee on Science and Technology.

As for President Reagan's policies regarding the US space program, a few statements may provide an indication of his views. In his 18 February 1981 statement to Congress on economic recovery, he said that while "we plan to continue" the space program, "we believe ... that a reordering of priorities to focus on the most important and cost effective NASA programs can result in a savings of a quarter of a billion dollars." This was followed by a fiscal year 1982 NASA budget request that was $600 million less than what had been proposed by President Carter. With the shuttle being exempted from any cuts, the reduction was accomplished by cancelling or deferring all fiscal year 1981 and 1982 new program starts in space science, applications, and aeronautics.

The long-term plans for NASA in the Reagan administration may show a continued slowing of funding for the agency. In its budget guidelines for fiscal years 1983–1985, the OMB told NASA to reduce its projected funding requirements, previously established under President Carter, by a total of $2.36 billion. Despite the congressional interest in space noted earlier, Congress appropriated only $5.932 billion for NASA in 1982, an amount which represents an additional

$190 million cut from the $600 million President Reagan had requested.

In the area of policy development, President Reagan abolished the PRC (Space), established within the NSC by President Carter, and after several months of ambivalence on a science advisor, chose Dr. George Keyworth for that post. On 28 April 1981, two weeks after the first successful flight of the space shuttle, the President again addressed Congress on the topic of economic recovery. He stated, "the space shuttle did more than prove our technological abilities. It raised our expectations once more. It started us dreaming again."

In an address to the American Association for the Advancement of Science on 25 June 1981, Dr. Keyworth revealed that the Reagan administration, spurred by a successful shuttle flight, had initiated a major interagency review of the shuttle's operational future and other matters concerning the direction of the space program.

Since that announcement, there have been more shuttle flights, and the Reagan administration has delivered several announcements on its intentions in national space policy. The President formally announced a revised national space policy at the welcome home ceremonies for the landing of the final test flight of the space shuttle on 4 July 1982. What these new policies will ultimately mean for our national space program remains to be seen as of this writing. The time may be ripe for the resolution of some of the issues which have marked the history of the national space program, such as the competition among civilian, military, and other national interests.

DECISION POINT

In its report on 1980 space policy hearings, the House Science and Technology Committee's Subcommittee on Space Science and Applications recommended that "the civil and military space programs should be examined separately and their funding adjusted to the requirements developed for each program."[42] Unlike NASA under this budgeting scheme, DOD has fared well as its reliance on space-based systems

has grown. The military depends on satellites for such things as (a) communications, command, and control links to strategic and tactical forces; (b) early warning and attack assessment, intelligence collection, and verification of treaty compliance for the National Command Authority; and (c) service as a "force multiplier" of land, sea, and air forces throughout any potential conflict.

In the authorization process during calendar year 1981, DOD's budget exceeded NASA's space budget by nearly $200 million (table 1). When the fiscal year 1982 budget was finally passed in December 1981, DOD's space appropriation outstripped the whole of NASA's (including aeronautics) by nearly half a billion dollars (tables 1–1 and 1–2). Compared to the budget requests for the two agencies submitted by OMB to Congress for fiscal year 1983, the difference is remarkable; NASA's is $6.6 billion and DOD's is $8.5 billion.

With regard to the civilian-military schism, although the relationship of military and civilian space programs had not been directly addressed in early 1982 legislative initiatives in the Congress, some views expressed in hearings seem to reinforce continued separation of agency activities. However, the line between military and civilian programs is becoming increasingly blurred because of the space shuttle. Clearly, this nation is at a decision point with respect to future space activity. The situation currently being experienced is not unlike the post-Apollo period wherein much bureaucratic debate took place but no national consensus emerged. Similarly, what the post-shuttle development period holds is unknown.

The answers to the future lie in national policy emanating from the highest levels of the executive branch, in firm programs to carry out that policy with an appropriate push from DOD and NASA leadership, and in adequate funding from the legislative branch.

APPENDIX A
INTERNATIONAL SPACE TREATIES

TEXT OF THE TREATY ON PRINCIPLES GOVERNING THE ACTIVITIES OF STATES IN THE EXPLORATION AND USE OF OUTER SPACE, INCLUDING THE MOON AND OTHER CELESTIAL BODIES (1967)

The States Parties to this Treaty,

Inspired by the great prospects opening up before mankind as a result of man's entry into outer space,

Recognising the common interest of all mankind in the progress of the exploration and use of outer space for peaceful purposes,

Believing that the exploration and use of outer space should be carried on for the benefit of all peoples irrespective of the degree of their economic or scientific development,

Desiring to contribute to broad international cooperation in the scientific as well as the legal aspects of the exploration and use of outer space for peaceful purposes,

Believing that such co-operation will contribute to the development of mutual understanding and to the strengthening of friendly relations between States and peoples,

Recalling resolution 1962 (XVIII), entitled "Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space", which was adopted unanimously by the United Nations General Assembly on 13 December 1963,

Recalling resolution 1884 (XVIII), calling upon States to refrain from placing in orbit around the earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction or from installing such weapons on celestial bodies, which was adopted unanimously by the United Nations General Assembly on 17 October 1963,

Taking account of United Nations General Assembly resolution 110 (II) of 3 November 1947, which condemned propaganda designed or likely to provoke or encourage any threat to the peace, breach of the peace or act of aggression, and considering that the aforementioned resolution is applicable to outer space,

Convinced that a Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, will further the Purposes and Principles of the Charter of the United Nations,

Have agreed on the following:

Article I

The exploration and use of outer space, including the moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind.

Outer space, including the moon and other celestial bodies, shall be free for exploration and use by all States without discrimination of any kind, on a basis of equality and in accordance with international law, and there shall be free access to all areas of celestial bodies.

There shall be freedom of scientific investigation in outer space, including the moon and other celestial bodies, and States shall facilitate and encourage international co-operation in such investigation.

Article II

Outer space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.

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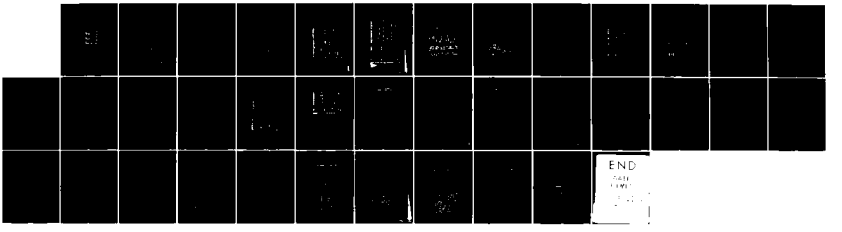

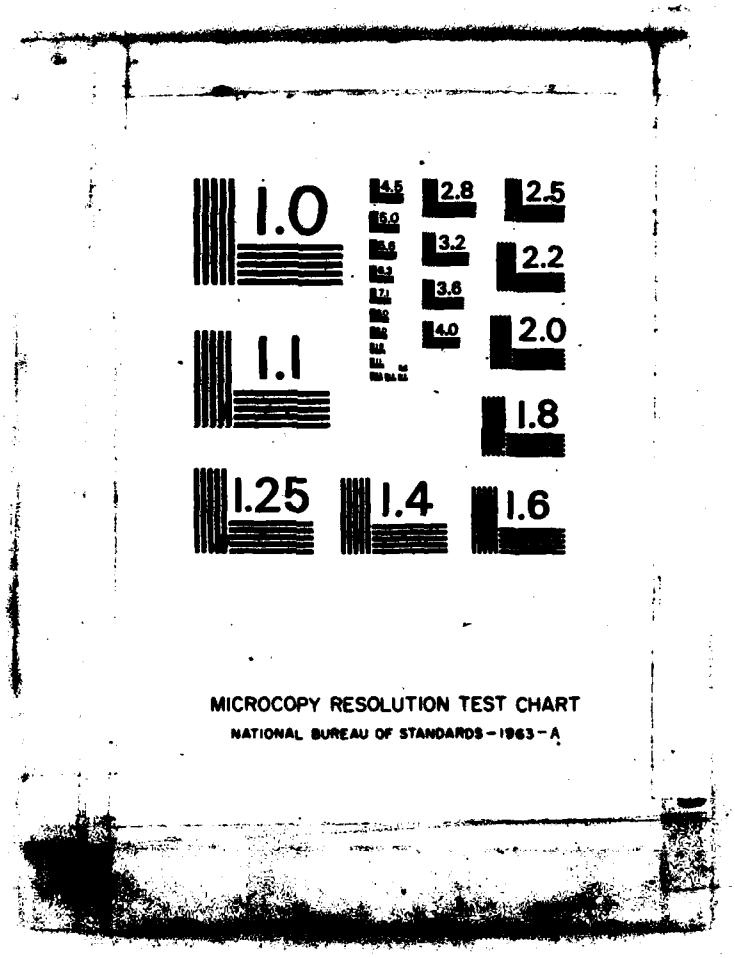
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Article III

States Parties to the Treaty shall carry on activities in the exploration and use of outer space, including the moon and other celestial bodies, in accordance with international law, including the Charter of the United Nations, in the interest of maintaining international peace and security and promoting international co-operation and understanding.

Article IV

States Parties to the Treaty undertake not to place in orbit around the earth any objects carrying nuclear weapons or any other kinds of weapons on celestial bodies, or station such weapons in outer space in any other manner.

The moon and other celestial bodies shall be used by all States Parties to the Treaty exclusively for peaceful purposes. The establishment of military bases, installations and fortifications, the testing of any type of weapons and the conduct of military manoeuvres on celestial bodies shall be forbidden. The use of military personnel for scientific research or for any other peaceful purposes shall not be prohibited. The use of any equipment or facility necessary for peaceful exploration of the moon and other celestial bodies shall also not be prohibited.

Article V

States Parties to the Treaty shall regard astronauts as envoys of mankind in outer space and shall render to them all possible assistance in the event of accident, distress, or emergency landing on the territory of another State Party or on the high seas. When astronauts make such a landing, they shall be safely and promptly returned to the State of registry of their space vehicle.

In carrying on activities in outer space and on celestial bodies, the astronauts of one State Party shall render all possible assistance to the atronauts of other States Parties.

States Parties to the Treaty shall immediately inform the other States Parties to the Treaty or the Secretary-General of the United Nations of any phenomena they discover in outer space, including the moon and other celestial bodies, which could constitute a danger to the life or health of astronauts.

Article VI

States Parties to the Treaty shall bear international responsibility for national activities in outer space, including the moon and other celestial bodies, whether such activities are carried on by governmental agencies or by non-governmental entities, and for assuring that national activities are carried out in conformity with the provisions set forth in the present Treaty. The activities of non-governmental entities in outer space, including the moon and other celestial bodies, shall require authorization and continuing supervision by the State concerned. When activities are carried on in outer space, including the moon and other celestial bodies, by an international organization, responsibility for compliance with this Treaty shall be borne both by the international organization and by the States Parties to the Treaty participating in such organization.

Article VII

Each State Party to the Treaty that launches or procures the launching of an object into outer space, including the moon and other celestial bodies, and each State Party from whose territory or facility an object is launched, is internationally liable for damage to another State Party to the Treaty or to its natural or judicial persons by such subject or its component parts on the Earth, in air space or in outer space, including the moon and other celestial bodies.

Article VIII

A State Party to the Treaty on whose registry an object launched into outer space is carried shall retain jurisdiction and control over such object, and over any personnel thereof, while in outer space or on a celestial body. Ownership of objects launched into outer space, including objects landed or constructed on a celestial body, and of their component parts, is not affected by their presence in

outer space or on a celestial body or by their return to the Earth. Such objects or component parts found beyond the limits of the State Party to the Treaty on whose registry they are carried shall be returned to that State, which shall, upon request, furnish identifying data prior to their return.

Article IX

In the exploration and use of outer space, including the moon and other celestial bodies, States Parties to the Treaty shall be guided by the principle of co-operation and mutual assistance and shall conduct all their activities in outer space, including the moon and other celestial bodies, with due regard to the corresponding interests of all other States Parties to the Treaty. States Parties to the Treaty shall pursue studies of outer space, including the moon and other celestial bodies, and conduct exploration of them so as to avoid their harmful contamination and also adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter and, where necessary, shall adopt appropriate measures for this purpose. If a State Party to the Treaty has reason to believe that an activity or experiment planned by it or its nationals in outer space, including the moon and other celestial bodies, would cause potentially harmful interference with activities of other States Parties in the peaceful exploration and use of outer space, including the moon and other celestial bodies, it shall undertake appropriate international consultations before proceeding with any such activity or experiment. A State Party to the Treaty which has reason to believe that an activity or experiment planned by another State Party in outer space, including the moon and other celestial bodies, would cause potentially harmful interference with activities in the peaceful exploration and use of outer space, including the moon and other celestial bodies, may request consultation concerning the activity or experiment.

Article X

In order to promote international co-operation in the exploration and use of outer space, including the moon and other celestial bodies, in conformity with the purposes of this Treaty, the States Parties to the Treaty shall consider on a basis of equality and requests by other States Parties to the Treaty to be afforded an opportunity to observe the flight of space objects launched by those States.

The nature of such an opportunity for observation and the conditions under which it could be afforded shall be determined by agreement between the States concerned.

Article XI

In order to promote international co-operation in the peaceful exploration and use of outer space, States Parties to the Treaty conducting activities in outer space, including the moon and other celestial bodies, agree to inform the Secretary-General of the United Nations as well as the public and the international scientific community, to the greatest extent feasible and practicable, of the nature, conduct, locations and results of such activities. On receiving the said information, the Secretary-General of the United Nations should be prepared to disseminate it immediately and effectively.

Article XII

All stations, installations, equipment and space vehicles on the moon and other celestial bodies shall be open to representatives of other States Parties to the Treaty on a basis of reciprocity. Such representatives shall give reasonable advance notice of a projected visit, in order that appropriate consultations may be held and that maximum precautions may be taken to assure safety and to avoid interference with normal operations in the facility to be visited.

Article XIII

The provisions of this Treaty shall apply to the activities of States Parties to the Treaty in exploration and use of outer space, including the moon and other celestial bodies, whether such activities are carried on by a single State Party to the Treaty or jointly with other States, including cases where they are carried on within the framework of international inter-governmental organizations.

Any practical questions arising in connexion with activities carried on by international inter-governmental organisations in the exploration and use of outer space, including the moon and other celestial bodies, shall be resolved by the States Parties to the Treaty either with the appropriate international organisation or with one or more States members of that international organisation, which are Parties to this Treaty.

Article XIV

1. This Treaty shall be open to all States for signature. Any State which does not sign this Treaty before its entry into force in accordance with paragraph 3 of this article may accede to it at any time.

2. This Treaty shall be subject to ratification by signatory States. Instruments of ratification and instruments of accession shall be deposited with the Governments of the Union of Soviet Socialist Republics, the United Kingdom of Great Britain and Northern Ireland and the United States of America, which are hereby designated the Depositary Governments.

3. This Treaty shall enter into force upon the deposit of instruments of ratification by five Governments including the Governments designated as Depositary Governments under this Treaty.

4. For States whose instruments of ratification or accession are deposited subsequent to the entry into force of this Treaty, it shall enter into force on the date of the deposit of their instruments of ratification or accession.

5. The Depositary Governments shall promptly inform all signatory and acceding States of the date of each signature, the date of deposit of each instrument of ratification of and accession to this Treaty, the date of its entry into force and other notices.

6. This Treaty shall be registered by the Depositary Governments pursuant to Article 102 of the Charter of the United Nations.

Article XV

Any State Party to the Treaty may propose amendments to this Treaty. Amendments shall enter into force for each State Party to the Treaty accepting the amendments upon their acceptance by a majority of the States Parties to the Treaty and thereafter for each remaining State Party to the Treaty on the date of acceptance by it.

Article XVI

Any State Party to the Treaty may give notice of its withdrawal from the Treaty one year after its entry into force by written notification to the Depositary Governments. Such withdrawal shall take effect one year from the date of receipt of this notification.

Article XVII

This Treaty, of which the Chinese, English, French, Russian and Spanish texts are equally authentic, shall be deposited in the archives of the Depositary Governments. Duly certified copies of this Treaty shall be transmitted by the Depositary Governments to the Governments of the signatory and acceding States.

IN WITNESS WHEREOF the undersigned, duly authorized, have signed this Treaty.

DONE in ————————, at the cities of London, Moscow and Washington, the —— day of———————— one thousand nine hundred and————————.

List of States that have Deposited Instruments of Ratification of (or Accession to) the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies. Opened for signature at Washington, London, and Moscow, January 27, 1967. Entered into force October 10, 1967. "Treaties and Other International Acts" (TIAS 6347)

Totals as of July 1975:

Signatures: 90 plus the Ukrainian S.S.R. and Byelorussian SSR.
Ratifications: 55 plus the Byelorussian S.S.R. and Ukrainian S.S.R.
Accessions: 11.
Notification that it continues to be bound: 8.

THE OUTER SPACE TREATY

	Washington		Moscow[1]		London[1]	
Country:	Signature	Ratification	Signature	Ratification	Signature	Ratification
United States	Jan. 27, 1967	Oct. 10, 1967	Jan. 27, 1967	Oct. 10, 1967	Jan. 27, 1967	Oct. 10, 1967
United Kingdom	do	do.[2]	do	do.[3]	do	Do.[3]
U.S.S.R.	do	do	do	do	do	Do.
Afghanistan	do		Jan. 30, 1967			
Argentina	do	Mar. 26, 1968	Apr. 18, 1967	Mar. 26, 1968		
Australia	do	Oct. 10, 1967		Oct. 10, 1967		Do.
Austria	Feb. 28, 1967	Feb. 26, 1968	Feb. 28, 1967	Feb. 26, 1968	Feb. 28, 1967	Feb. 26, 1968
Belgium	Feb. 2, 1967	Mar. 30, 1973	Jan. 27, 1967	Mar. 31, 1973	Jan. 27, 1967	Mar. 31, 1973
Bolivia	Jan. 27, 1967					
Botswana	do					
Brazil	Feb. 2, 1967	Mar. 5, 1968[3]	Jan. 30, 1967	Mar. 5, 1968	Feb. 2, 1967	[3] Mar. 5, 1968
Bulgaria	Jan. 27, 1967	Apr. 11, 1967	Jan. 27, 1967	Mar. 28, 1967	Jan. 27, 1967	Apr. 19, 1967
Burma	May 22, 1967	Mar. 18, 1970	May 22, 1967	Mar. 18, 1970	May 22, 1967	Mar. 18, 1970
Burundi	Jan. 27, 1967					
Byelorussian S.S.R.			Feb. 18, 1967	Oct. 31, 1976		
Cameroon	do					
Canada	do	Oct. 10, 1967	Jan. 27, 1967	Oct. 10, 1967	Jan. 27, 1967	Oct. 10, 1967
Central African Republic	do					
Chile	do		Feb. 28, 1967		Feb. 3, 1967	
China, Republic of	do	July 24, 1970				
Colombia	do					
Cyprus	do	July 5, 1972	Feb. 15, 1967	Sept. 20, 1972	Feb. 16, 1967	July 5, 1972
Czechoslovakia	do	May 22, 1967	Jan. 27, 1967	May 18, 1967	Jan. 27, 1967	May 11, 1967
Denmark	do	Oct. 10, 1967	do	Oct. 10, 1967	do	Oct. 10, 1967
Dominican Republic	do	Nov. 21, 1968				
Ecuador	do	Mar. 7, 1969	June 7, 1967		May 16, 1967	
Egypt, Arab Republic of	do	Oct. 10, 1967	Jan. 27, 1967	Jan. 23, 1968		
El Salvador	do	Jan. 15, 1969				
Ethiopia	do		Feb. 10, 1967		Jan. 27, 1967	
Finland	do	July 12, 1967	Jan. 27, 1967	July 12, 1967	do	July 12, 1967
France	Sept. 25, 1967	Aug. 5, 1970	Sept. 25, 1967	Aug. 5, 1970	Sept. 25, 1967	Aug. 5, 1970
Gambia					June 2, 1967	
German Democratic Republic			Jan. 27, 1967	Feb. 2, 1967		
Germany, Federal Republic	Jan. 27, 1967	[4] Feb. 10, 1971	Jan. 27, 1967		Jan. 27, 1967	[4] Feb. 10, 1971
Ghana	Jan. 27, 1967		Feb. 15, 1967		Mar. 9, 1967	
Greece	Jan. 27, 1967					Jan. 19, 1971
Guyana	Feb. 3, 1967					
Haiti	Jan. 27, 1967					
Honduras	Jan. 27, 1967					
Holy See					Apr. 6, 1967	
Hungary	Jan. 27, 1967	June 26, 1967	Jan. 27, 1967	June 26, 1967	Jan. 27, 1967	June 26, 1967
Iceland	Jan. 27, 1967	Feb. 5, 1968	Jan. 27, 1967	Feb. 5, 1968	Jan. 27, 1967	Feb. 5, 1968
India	Mar. 3, 1967		Mar. 3, 1967		Mar. 3, 1967	
Indonesia	Jan. 27, 1967		Jan. 30, 1967		Feb. 14, 1967	
Iran					Jan. 27, 1967	
Iraq	Feb. 27, 1967		Mar. 6, 1967	Dec. 4, 1968	Feb. 27, 1967	Sept. 23, 1969
Ireland	Jan. 27, 1967	July 17, 1968			Jan. 27, 1967	July 19, 1963
Israel	do		Jan. 27, 1967		do	
Italy	do	May 4, 1972	do	May 4, 1972	do	May 4, 1972
Jamaica	June 29, 1967	Aug. 6, 1970	June 29, 1967	Aug. 21, 1970	June 29, 1967	Aug. 10, 1970
Japan	Jan. 27, 1967	Oct. 10, 1967	Jan. 27, 1967	Oct. 10, 1967	Jan. 27, 1967	Oct. 10, 1967

See footnotes at end of table, p. 46.

THE OUTER SPACE TREATY—Continued

	Washington		Moscow [1]		London [1]	
	Signature	Ratification	Signature	Ratification	Signature	Ratification
Country—Continued						
Jordan	Feb. 2, 1967					
Korea, Republic of	Jan. 27, 1967	Oct. 13, 1967				
Laos	do	Nov. 29, 1972	Feb. 2, 1967	Nov. 27, 1972	Jan. 30, 1967	Jan. 15, 1973
Lebanon	Feb. 23, 1967	June 30, 1969	Feb. 23, 1967	Mar. 31, 1969	Feb. 23, 1967	Mar. 31, 1969
Lesotho	Jan. 27, 1967					
Luxembourg	do		Jan. 27, 1967		Jan. 31, 1967	
Malaysia	Feb. 20, 1967		May 3, 1967		Feb. 21, 1967	
Mexico	Jan. 27, 1967	Jan. 31, 1968	Jan. 27, 1967	Jan. 31, 1968	Jan. 27, 1967	Jan. 31, 1968
Mongolia			do	Oct. 10, 1967		
Nepal	Feb. 3, 1967	Nov. 22, 1967	Feb. 3, 1967	Oct. 10, 1967	Feb. 6, 1967	Oct. 10, 1967
Netherlands	Feb. 10, 1967	Oct. 10, 1969 [7]	Feb. 10, 1967	Oct. 10, 1969 [7]	Feb. 10, 1967 [7]	Oct. 10, 1969 [7]
New Zealand	Jan. 27, 1967	May 31, 1968	Jan. 27, 1967	May 31, 1968	Jan. 27, 1967	May 31, 1968
Nicaragua	do				Feb. 13, 1967	
Niger	Feb. 1, 1967	May 3, 1967				Apr. 17, 1967
Norway	Feb. 3, 1967	July 1, 1969	Feb. 3, 1967	July 1, 1969	Feb. 3, 1967	July 1, 1969
Pakistan	Sept. 12, 1967	Apr. 8, 1968	Sept. 12, 1967	Apr. 8, 1968	Sept. 12, 1967	Apr. 8, 1968
Panama	Jan. 27, 1967					
Peru	June 30, 1967					
Philippines	Jan. 27, 1967		Apr. 28, 1967		Jan. 27, 1967	
Poland	do	Jan. 30, 1968	Jan. 27, 1967	Jan. 30, 1968	do	Jan. 30, 1968
Romania	do	Apr. 9, 1968	do	Apr. 9, 1968	do	Apr. 9, 1968
Rwanda	do					
San Marino	Apr. 21, 1967	Oct. 20, 1969	June 6, 1967	Nov. 21, 1969	Apr. 24, 1967	Feb. 3, 1969
Sierra Leone	May 16, 1967	July 14, 1967	Jan. 27, 1967	July 19, 1967	Jan. 27, 1967	Oct. 25, 1967
Somalia	Feb. 2, 1967					
South Africa	Mar. 1, 1967	Sept. 30, 1969				Oct. 6, 1969
Sri Lanka					Mar. 10, 1967	
Sweden	Jan. 27, 1967	Oct. 11, 1967	do	Oct. 11, 1967	Jan. 27, 1967	Oct. 11, 1967
Switzerland	do	Dec. 10, 1969	Jan. 30, 1967	Dec. 10, 1969	do	Dec. 10, 1969
Thailand	do	Sept. 10, 1969	Jan. 27, 1967	Sept. 9, 1969	do	Sept. 9, 1969
Togo	do					
Trinidad and Tobago	Sept. 26, 1967		Aug. 17, 1967		July 24, 1967	
Tunisia	Jan. 27, 1967	Apr. 17, 1968	Feb. 15, 1967	Apr. 4, 1968	Jan. 27, 1967	Mar. 28, 1968
Turkey	do	Mar. 27, 1968	Jan. 27, 1967	Mar. 27, 1968	do	Mar. 27, 1968
Ukrainian S.S.R.			Feb. 10, 1967 [4]	Oct. 31, 1967		
Upper Volta	Mar. 3, 1967	June 16, 1969				
Uruguay	Jan. 27, 1967	Aug. 31, 1970	Jan. 30, 1967			
Venezuela	do	Mar. 3, 1970				
Vietnam	do					
Yugoslavia	do		Jan. 27, 1967		do	
Zaire	do		Apr. 28, 1967		May 4, 1967	

	Accession	Accession	Accession
Country:			
Morocco	Dec. 22, 1967	Dec. 21, 1967	Dec. 21, 1967
Uganda	Apr. 24, 1968		
Libya	July 9, 1968		
Nigeria			Nov. 14, 1967
Malagasy Republic	Aug. 22, 1968 [8]		
Barbados	Sept. 12, 1968		
Mali		June 11, 1968	
Spain	Dec. 7, 1968		Nov. 27, 1968
Syrian Arab Republic		Nov. 18, 1968	
Kuwait	June 7, 1972	July 4, 1972	June 29, 1972
Zambia	Aug. 28, 1973	Aug. 21, 1973	Aug. 28, 1973

DATE OF NOTIFICATION THAT IT CONTINUES TO BE BOUND

	Washington	Moscow	London
Country:			
Mauritius	Apr. 16, 1968	May 13, 1968	Apr. 23, 1968
Tonga	July 7, 1971		June 22, 1971
Fiji	July 14, 1972		July 14, 1972

[1] The listings for signings in Moscow and London are based upon official reports received.
Extended to the territories under the territorial sovereignty of the United Kingdom and to Antigua, British Solomon Islands Protectorate, Brunei, Dominica, Grenada, St. Christopher-Nevis-Anguilla, and St. Lucia. Treaty is not applicable to Rhodesia.
[2] With a declaration.
[3] The United States considers this Republic as already covered by the signature affixed to the treaty by the U.S.S.R.
[4] The United States made a statement regarding this action.
Applicable to Land Berlin.
[7] Applicable to Suriname and the Netherlands Antilles.
[8] With a statement.

Text of the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched Into Outer Space (1968)

The Contracting Parties,

Noting the great importance of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, which calls for the rendering of all possible assistance to astronauts in the event of accident, distress or emergency landing, the prompt and safe return of astronauts and the return of objects launched into outer space.

Desiring to develop and give further concrete expression to these duties,

Wishing to promote international co-operation in the peaceful exploration and use of outer space,

Prompted by sentiments of humanity,

Have agreed on the following:

Article 1

Each Contracting Party which receives information or discovers that the personnel of a spacecraft have suffered accident or are experiencing conditions of distress or have made an emergency or unintended landing in territory under its jurisdiction or on the high seas or in any other place not under the jurisdiction of any State shall immediately:

(a) Notify the launching authority or, if it cannot identify and immediately communicate with the launching authority, immediately make a public announcement by all appropriate means of communication at its disposal; and

(b) Notify the Secretary-General of the United Nations who should disseminate the information without delay by all appropriate means of communication at his disposal.

Article 2

If, owing to accident, distress, emergency or unintended landing, the personnel of a spacecraft land in territory under the jurisdiction of a Contracting Party, it shall immediately take all possible steps to rescue them and render them all necessary assistance. It shall inform the launching authority and also the Secretary-General of the United Nations of the steps it is taking and of their progress. If assistance by the launching authority would help to effect a prompt rescue or would contribute substantially to the effectiveness of search and rescue operations, the launching authority shall co-operate with the Contracting Party with a view to the effective conduct of search and rescue operations. Such operations shall be subject to the direction and control of the Contracting Party, which shall act in close and continuing consultation with the launching authority.

Article 3

If information is received or it is discovered that the personnel of a spacecraft have alighted on the high seas or in any other place not under the jurisdiction of any State, those Contracting Parties which are in a position to do so shall, if necessary, extend assistance in search and rescue operations for such personnel to ensure their speedy rescue. They shall inform the launching authority and the Secretary-General of the United Nations of the steps they are taking and of their progress.

Article 4

If, owing to accident, distress, emergency or unintended landing, the personnel of a spacecraft land in territory under the jurisdiction of a Contracting Party or have been found on the high seas or in any other place not under the jurisdiction of any State, they shall be safely and promptly returned to representatives of the launching authority.

Article 5

1. Each Contracting Party which receives information or discovers that a space object or its component parts has returned to Earth in territory under its jurisdiction or on the high seas or in any other place not under the jurisdiction of any State, shall notify the launching authority and the Secretary-General of the United Nations.

2. Each Contracting Party having jurisdiction over the territory on which a space object or its component parts has been discovered shall, upon the request of the launching authority and with assistance from that authority if requested, take such steps as it finds practicable to recover the object or component parts.

3. Upon request of the launching authority, objects launched into outer space or their component parts found beyond the territorial limits of the launching authority shall be returned to or held at the disposal of representatives of the launching authority, which shall, upon request, furnish identifying data prior to their return.

4. Notwithstanding paragraphs 2 and 3 of this article, a Contracting Party which has reason to believe that a space object or its component parts discovered in territory under its jurisdiction, or recovered by it elsewhere, is of a hazardous or deleterious nature may so notify the launching authority which shall immediately take effective steps, under the direction and control of the said Contracting Party to eliminate possible danger or harm.

5. Expenses incurred in fulfilling obligations to recover and return a space object or its component parts under paragraphs 2 and 3 of this article shall be borne by the launching authority.

Article 6

For the purposes of this Agreement, the term "launching authority" shall refer to the State responsible for launching, or, where an international intergovernmental organization is responsible for launching, that organization provided that that organization declares its acceptance of the rights and obligations provided for in this Agreement and a majority of the States members of that organization are Contracting Parties to this Agreement and to the Treaty on Principles Governing the Activities of States in Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies.

Article 7

1. This Agreement shall be open to all States for signature. Any State which does not sign this Agreement before its entry into force in accordance with paragraph 3 of this article may accede to it at any time.

2. This Agreement shall be subject to ratification by signatory States. Instruments of ratification and instruments of accession shall be deposited with the Governments of the United States of America, the United Kingdom of Great Britain and Northern Ireland and the Union of Soviet Socialist Republics, which are hereby designated the Depositary Governments.

3. This Agreement shall enter into force upon the deposit of instruments of ratification by five Governments including the Governments designated as Depositary Governments under this Agreement.

4. For States whose instruments of ratification or accession are deposited subsequent to the entry into force of this Agreement, it shall enter into force on the date of the deposit of their instruments of ratification or accession.

5. The Depositary Governments shall promptly inform all signatory and acceding States of the date of each signature, the date of deposit of each instrument of ratification of and accession to this Agreement, the date of its entry into force and other notices.

6. This Agreement shall be registered by the Depositary Governments pursuant to Article 102 of the Charter of the United Nations.

Article 8

Any State Party to the Agreement may propose amendments to this Agreement. Amendments shall enter into force for each State Party to the Agreement accepting the amendments upon their acceptance by a majority of the States Parties to the Agreement and thereafter for each remaining State Party to the Agreement on the date of acceptance by it.

Article 9

Any State Party to the Agreement may give notice of its withdrawal from the Agreement one year after its entry into force by written notification to the Depositary Governments. Such withdrawal shall take effect one year from the date of receipt of this notification.

Article 10

This Agreement, of which the English, Russian, French, Spanish and Chinese texts are equally authentic, shall be deposited in the archives of the Depositary Governments. Duly certified copies of this Agreement shall be transmitted by the Depositary Governments to the Governments of the signatory and acceding States.

In Witness Whereof the undersigned, duly authorized, have signed this Agreement.

Done in ————, copies at ————.

List of States that have Deposited Instrumentr of Ratification of (or Accession to) the Agreement on the Rescue of Astronauts, the Return of Astronauts, and the Return of Objects Launched into Outer Space. Opened for signature at Washington, London, and Moscow, April 22, 1968. Entered into force December 3, 1968. "Treaties and Other International Acts" (TIAS 6599).

Totals as of July 1975:

Signatures: 79 plus the Ukrainian S.S.R. and Byelorussian S.S.R.
Ratifications: 47 plus the Byelorussian S.S.R. and Ukrainian S.S.R.
Accession: 13.
Notification that it continues to be bound: 2.

THE ASTRONAUT AGREEMENT

	Washington		Moscow[1]		London[1]	
Country:	Signature	Ratification	Signature	Ratification	Signature	Ratification
United States	Apr. 22, 1968	Dec. 3, 1968	Apr. 22, 1968	Dec. 3, 1968	Apr. 22, 1968	Dec. 3, 1968
United Kingdom	do	do.[1]	do	do.[2]	do	Do.[1]
U.S.S.R.	do	do	do	do	do	Do.
Argentina	do	Mar. 26, 1969	May 28, 1968	Mar. 26, 1969	May 2, 1968	Mar. 26, 1969
Australia	do		Apr. 22, 1968		Apr. 22, 1968	
Austria	do	Feb. 19, 1970	do	Feb. 19, 1970	do	Feb. 19, 1970
Belgium	Aug. 14, 1968		Aug. 14, 1968		Aug. 14, 1968	
Bolivia	Apr. 22, 1968					
Bulgaria	do	Apr. 16, 1969	Apr. 22, 1968	Apr. 2, 1969	Apr. 22, 1968	Apr. 16, 1969
Burma	Aug. 21, 1968		Aug. 21, 1968		Aug. 21, 1968	
Byelorussian S.S.R.			May 14, 1968[3]	Dec. 2, 1968[3]		
Cameroon			June 14, 1968		Apr. 22, 1968	Jan. 10, 1969
Canada	Apr. 22, 1968	Feb. 20, 1975	Apr. 22, 1968		Apr. 22, 1968	Feb. 20, 1975
Chile	Apr. 22, 1968		May 16, 1968		Apr. 22, 1968	
China, Republic of	do	June 15, 1973				
Colombia	Apr. 23, 1968					
Costa Rica	Apr. 24, 1968					
Cyprus	May 9, 1968	Jan. 29, 1971	July 9, 1968	Dec. 17, 1970	May 7, 1968	Dec. 17, 1970
Czechoslovakia	Apr. 22, 1968	Feb. 18, 1969	Apr. 22, 1968	Feb. 18, 1969	Apr. 22, 1968	Feb. 18, 1969
Denmark	do	May 6, 1969	do	May 6, 1969	do	May 6, 1969
Dominican Republic	do					
Ecuador	do	Mar. 7, 1969				
Egypt, Arab Republic of			July 4, 1968	Dec. 11, 1968	May 10, 1968	
El Salvador	Apr. 22, 1968	Feb. 19, 1970				
Finland	do	Sept. 10, 1970	Apr. 22, 1968	Sept. 10, 1970	Apr. 22, 1968	Sept. 10, 1970
Gambia	Sept. 26, 1968					
German Democratic Republic			Apr. 22, 1968[4]	Dec. 11, 1968		
Germany, Federal Republic of	Aug. 20, 1968	Feb. 17, 1972[4]	Aug. 20, 1968		Aug. 20, 1968[4]	Feb. 17, 1972
Ghana	Apr. 22, 1968		Apr. 22, 1968		May 6, 1968	
Greece	June 11, 1968					
Guyana					Oct. 4, 1968	May 30, 1969
Haiti	Apr. 22, 1968					
Hungary	do	June 4, 1968	Apr. 22, 1968	June 4, 1968	Apr. 22, 1968	June 4, 1968
Iceland	do	Dec. 4, 1968	do	Dec. 4, 1968	do	Dec. 4, 1968
Iran	do	Dec. 21, 1970	do	Dec. 24, 1970	do	Dec. 21, 1970
Ireland	do	Sept. 6, 1968			do	Aug. 29, 1968
Israel	do	Dec. 19, 1969			Apr. 26, 1968	Jan. 6, 1970
Italy	do		Apr. 22, 1968		Apr. 22, 1968	
Jamaica	July 23, 1968		July 23, 1968		July 23, 1968	
Jordan					July 24, 1968	
Korea, Republic of	May 9, 1968	Apr. 4, 1969				
Laos	Apr. 22, 1968	Nov. 29, 1972	Apr. 22, 1968	Nov. 27, 1972	Apr. 22, 1968	Jan. 15, 1973
Lebanon	do	June 30, 1969	Apr. 30, 1968	Mar. 31, 1969	Apr. 30, 1968	Mar. 31, 1969
Lesotho	July 18, 1968					
Luxembourg	Aug. 14, 1968		Aug. 14, 1968		Aug. 14, 1968	
Malagasy Republic	June 25, 1968	Feb. 11, 1969				
Malaysia	June 18, 1968		July 4, 1968		July 29, 1968	
Maldive Islands	Apr. 22, 1968	Apr. 3, 1970				
Malta					May 29, 1968	
Mexico	July 15, 1968	Mar. 11, 1969	July 15, 1968	Mar. 11, 1969	July 15, 1968	Mar. 11, 1969
Monaco					June 13, 1968	
Mongolia			Apr. 22, 1968	Jan. 31, 1969		

See footnotes at end of table, p. 52.

THE ASTRONAUT AGREEMENT—Continued

Country—Continued	Washington		Moscow[1]		London[1]	
	Signature	Ratification	Signature	Ratification	Signature	Ratification
Morocco	Apr. 22, 1968	Dec. 21, 1970	June 7, 1968		June 14, 1968	Nov. 20, 1970
Nepal	do	July 11, 1968	Apr. 22, 1968	July 26, 1968	Apr. 22, 1968	Feb. 3, 1969
Netherlands	Aug. 14, 1968		Aug. 14, 1968		Aug. 14, 1968	
New Zealand	Apr. 24, 1968	July 8, 1969	Apr. 24, 1968	June 8, 1969	Apr. 24, 1968	July 8, 1969
Nicaragua	Apr. 22, 1968				June 13, 1968	
Niger	do	Jan. 15, 1969				Feb. 14, 1969
Nigeria	May 3, 1968		June 14, 1968	Feb. 26, 1973	July 26, 1968	Mar. 23, 1973
Norway	Apr. 22, 1968	Apr. 20, 1970	Apr. 22, 1968	Apr. 20, 1970	Apr. 22, 1968	Apr. 28, 1970
Philippines	Apr. 24, 1968					
Poland	Apr. 22, 1968	Feb. 14, 1969	Apr. 22, 1968	Feb. 14, 1969	Apr. 22, 1968	Feb. 14, 1969
Portugal	do	Mar. 25, 1970				
Romania	do	June 28, 1971	Apr. 22, 1968		Apr. 22, 1968	June 28, 1971
Rwanda	do					
San Marino	Nov. 7, 1968	Aug. 31, 1970	Nov. 21, 1968	Aug. 20, 1970		Aug. 10, 1970
Senegal					June 26, 1968	
Sierra Leone			Apr. 22, 1968		May 20, 1968	
Somali Republic	Apr. 22, 1968		do			
South Africa	Aug. 6, 1968	Oct. 6, 1969				Sept. 24, 1969
Switzerland	Apr. 22, 1968	Dec. 18, 1969	Apr. 22, 1968	Dec. 18, 1969	Apr. 22, 1968	Dec. 18, 1969
Syrian Arab Republic			Oct. 3, 1968	Aug. 14, 1969		
Tunisia	Apr. 22, 1968	Feb. 10, 1971	Apr. 24, 1968		Apr. 22, 1968	Feb. 15, 1971
Turkey	Nov. 28, 1968		Nov. 28, 1968		Nov. 28, 1968	
Ukrainian S.S.R.			June 28, 1968[2]	Jan. 16, 1969[2]		
Uruguay	Apr. 22, 1968					Feb. 25, 1969
Venezuela	do					
Vietnam					May 22, 1968	
Yemen Arab Republic			July 23, 1968			
Yugoslavia	Apr. 22, 1968	Mar. 1, 1971	Apr. 22, 1968		Apr. 22, 1968	Mar. 1, 1971
Zaire	do				June 25, 1969	

	Accession	Accession	Accession
Gambia		July 26, 1968	Aug. 2, 1968
Gabon	Apr. 2, 1969		
Mauritius	Apr. 16, 1969	May 13, 1969	Apr. 21, 1969
Botswana	Apr. 18, 1969	Apr. 18, 1969	Apr. 18, 1969
Barbados		Apr. 18, 1969	Feb. 28, 1969
Thailand	May 30, 1969	May 26, 1969	May 28, 1969
Swaziland	June 9, 1969	June 17, 1969	June 16, 1969
Sweden	July 21, 1969	July 21, 1969	July 21, 1969
Iraq		Mar. 12, 1970	May 7, 1970
Kuwait	June 7, 1972	July 4, 1972	June 20, 1972
Brazil	Feb. 27, 1973	Feb. 27, 1973	Feb. 27, 1973
Zambia	Aug. 28, 1973	Aug. 21, 1973	Aug. 28, 1973
Pakistan	Oct. 18, 1973	Oct. 17, 1973	Nov. 2, 1973

DATE OF NOTIFICATION THAT IT CONTINUES TO BE BOUND

Tonga	July 7, 1971		June 22, 1971
Fiji	July 18, 1972	July 14, 1972	July 14, 1972

[1] The listings for signings in Moscow and London are based upon official reports received.
[2] The United States considers this Republic as already covered by the signature and ratification of the treaty by the Union of Soviet Socialist Republics.
[3] The United States made a statement regarding this action.
[4] Applicable to Land Berlin.
[5] Extended to Antigua, British Solomon Islands Protectorate, Brunei, Dominica, Grenada, St. Christopher-Nevis-Anguilla, St. Lucia, and territories under the territorial sovereignty of the United Kingdom. Not applicable to Southern Rhodesia.

Text of the Convention on International Liability for Damage Caused by Space Objects (1972)

The States Parties to this Convention,

Recognising the common interest of all mankind in furthering the exploration and use of outer space for peaceful purposes,

Recalling the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies,

Taking into consideration that, notwithstanding the precautionary measures to be taken by States and international intergovernmental organizations involved in the launchig of space objects, damage may on occasion be caused by such objects,

Recognising the need to elaborate effective international rules and procedures concerning liability for damage caused by space objects and to ensure, in particular, the prompt payment under the terms of this Convention of a full equitable measure of compensation to victims of such damage,

Believing that the establishment of such rules and procedures will contri to the strengthening of international co-operation in the field of the explora and use of outer space for peaceful purposes,

Have agreed on the following:

Article I

For the purposes of this Convention:

(a) The term "damage" means loss of life, personal injury or other impairm of health; or loss of or damage to property of States or of persons, natural or juridical, or property of international intergovernmental organizations;

(b) The term "launching" includes attempted launching;

(c) The term "launching State" means:

(i) A State which launches or procures the launching of a space object;

(ii) A State from whose territory or facility a space object is launched;

(d) The term "space object" includes component parts of a space object as well as its launch vehicle and parts thereof.

Article II

A launching State shall be absolutely liable to pay compensation for damage caused by its space object on the surface of the earth or to aircraft in flight.

Article III

In the event of damage being caused elsewhere than on the surface of the earth to a space object of one launching State or to persons or property on board such a space object of another launching State, the latter shall be liable only if the damage is due to its fault or the fault of persons for whom it is responsible.

Article IV

1. In the event of damage being caused elsewhere than on the surface of the earth to a space object of one launching State or to persons or property on board such a space object by a space object of another launching State, and of damage thereby being caused to a third State or to its natural or juridical persons, the first two States shall be jointly and severally liable to the third State, to the extent indicated by the following:

(a) If the damage has been caused to the third State on the surface of the earth or to aircraft in flight, their liability to the third State shall be absolute;

(b) If the damage has been caused to a space object of the third State or to persons or property on board that space object elsewhere than on the surface of the earth, their liability to the third State shall be based on the fault of either of the first two States or on the fault of persons for whom either is responsible.

2. In all cases of joint and several liability referred to in paragraph 1, the burden of compensation for the damage shall be apportioned between the first two States in accordance with the extent to which they were at fault; if the extent of the fault of each of these States cannot be established, the burden of compensation shall be apportioned equally between them. Such apportionment shall be without prejudice to the right of the third State to seek the entire compensation due under this Convention from any or all of the launching States which are jointly and severally liable.

Article V

1. Whenever two or more States jointly launch a space object, they shall be jointly and severally liable for any damage caused.

2. A launching State which has paid compensation for damage shall have the right to present a claim for indemnification to other participants in the joint launching. The participants in a joint launching may conclude agreements regarding the apportioning among themselves of the financial obligation in respect of which they are jointly and severally liable. Such agreements shall be without prejudice to the right of a State sustaining damage to seek the entire compensation due under this Convention from any or all of the launching States which are jointly and severally liable.

3. A State from whose territory or facility a space object is launched shall be regarded as a participant in a joint launching.

Article VI

1. Subject to the provisions of paragraph 2, exoneration from absolute liability shall be granted to the extent that a launching State establishes that the damage has resulted either wholly or partially from gross negligence or from an act of omission done with intent to cause damage on the part of a claimant State or of natural or juridical persons it represents.

2. No exoneration whatever shall be granted in cases where the damage has resulted from activities conducted by a launching State which are not in conformity with international law including, in particular, the Charter of the United Nations and the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies.

Article VII

The provisions of this Convention shall not apply to damage caused by a space object of a launching State to:

(a) Nationals of that launching State;

(b) Foreign nationals during such time as they are participating in the operation of that space object from the time of its launching or at any stage thereafter until its descent, or during such time as they are in the immediate vicinity of a planned launching or recovery area as the result of an invitation by that launching State.

Article VIII

1. A State which suffers damage, or whose natural or juridical persons suffer damage, may present to a launching State a claim for compensation for such damage.

2. If the State of nationality has not presented a claim, another State may, in respect of damage sustained in its territory by any natural or juridical person, present a claim to a launching State.

3. If neither the State of nationality nor the State in whose territory the damage was sustained has presented a claim or notified its intention of presenting a claim, another State may, in respect of damage sustained by its permanent residents, present a claim to a launching State.

Article IX

A claim for compensation for damage shall be presented to a launching State through diplomatic channels. If a State does not maintain diplomatic relations with the launching State concerned, it may request another State to present its claim to that launching State or otherwise represent its interests under this Convention. It may also present its claim through the Secretary-General of the United Nations, provided the claimant State and the launching State are both Members of the United Nations.

Article X

1. A claim for compensation for damage may be presented to a launching State not later than one year following the date of the occurrence of the damage or the identification of the launching State which is liable.

2. If, however, a State does not know of the occurrence of the damage or has not been able to identify the launching State which is liable, it may present a claim within one year following the date on which it learned of the aforementioned facts; however, this period shall in no event exceed one year following the date on which the State could reasonably be expected to have learned of the facts through the exercise of due diligence.

3. The time-limits specified in paragraphs 1 and 2 shall apply even if the full extent of the damage may not be known. In this event, however, the claimant State shall be entitled to revise the claim and submit additional documentation after the expiration of such time-limits until one year after the full extent of the damage is known.

Article XI

1. Presentation of a claim to a launching State for compensation for damage under this Convention shall not require the prior exhaustion of any local remedies which may be available to a claimant State or to natural or juridical persons it represents.

2. Nothing in this Convention shall prevent a State, or natural or juridical persons it might represent, from pursuing a claim in the courts or administrative tribunals or agencies of a launching State. A State shall not, however, be entitled to present a claim under this Convention in respect of the same damage for which a claim is being pursued in the courts or administrative tribunals or agencies of a launching State or under another international agreement which is binding on the States concerned.

Article XII

The compensation which the launching State shall be liable to pay for damage under this Convention shall be determined in accordance with international law and the principles of justice and equity, in order to provide such reparation in respect of the damage as will restore the person, natural or juridical, State or international organization on whose behalf the claim is presented to the condition which would have existed if the damage had not occurred.

Article XIII

Unless the claimant State and the State from which compensation is due under this Convention agree on another form of compensation, the compensation shall be paid in the currency of the claimant State or, if that State so requests, in the currency of the State from which compensation is due.

Article XIV

If no settlement of a claim is arrived at through diplomatic negotiations as provided for in article IX, within one year from the date on which the claimant State notifies the launching State that it has submitted the documentation of its claim, the parties concerned shall establish a Claims Commission at the request of either party.

Article XV

1. The Claims Commission shall be composed of three members: one appointed by the claimant State, one appointed by the launching State and the third member, the Chairman, to be chosen by both parties jointly. Each party shall make its appointment within two months of the request for the establishment of the Claims Commission.

If no agreement is reached on the choice of the Chairman within four months of the request for the establishment of the Claims Commission, either party may request the Secretary-General of the United Nations to appoint the Chairman within a further period of two months.

Article XVI

1. If one of the parties does not make its appointment within the stipulated period, the Chairman shall, at the request of the other party, constitute a single-member Claims Commission.
2. Any vacancy which may arise in the Claims Commission for whatever reason shall be filled by the same procedure adopted for the original appointment.
3. The Claims Commission shall determine its own procedure.
4. The Claims Commission shall determine the place or places where it shall sit and all other administrative matters.
5. Except in the case of decisions and awards by a single-member Commission, all decisions and awards of the Claims Commission shall be by majority vote.

Article XVII

No increase in the membership of the Claims Commission shall take place by reason of two or more claimant States or launching States being joined in any one proceeding before the Commission. The claimant States so joined shall collectively appoint one member of the Commission in the same manner and subject to the same conditions as would be the case for a single claimant State. When two or more launching States are so joined, they shall collectively appoint one member of the Commission in the same way. If the claimant States or the launching States do not make the appointment within the stipulated period, the Chairman shall constitute a single-member Commission.

Article XVIII

The Claims Commission shall decide the merits of the claim for compensation and determine the amount of compensation payable, if any.

Article XIX

The Commission shall act in accordance with the provisions of article XII.
2. The decision of the Commission shall be final and binding if the parties have so agreed; otherwise the Commission shall render a final and recommendatory award, which the parties shall consider in good faith. The Commission shall state the reasons for its decision or award.
3. The Commission shall give its decision or award as promptly as possible and no later than one year from the date of its establishment unless an extension of this period is found necessary by the Commission.
4. The Commission shall make its decision or award public. It shall deliver a certified copy of its decision or award to each of the parties and to the Secretary-General of the United Nations.

Article XX

The expenses in regard to the Claims Commission shall be borne equally by the parties, unless otherwise decided by the Commission.

Article XXI

If the damage caused by a space object presents a large-scale danger to human life or seriously interferes with the living conditions of the population or the functioning of vital centres, the States Parties, and in particular the launching State, shall examine the possibility of rendering appropriate and rapid assistance to the State which has suffered the damage, when it so requests. However, nothing in this article shall affect the rights or obligations of the States Parties under this Convention.

Article XXII

1. In this Convention, with the exception of articles XXI to XXVII, references to States shall be deemed to apply to any international intergovernmental organization which conducts space activities if the organization declares is acceptance of the rights and obligations provided for in this Convention and if a

majority of the States members of the organization are States Parties to this Convention and to the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and other Celestial Bodies.

2. States members of any such organization which are States Parties to this Convention shall take all appropriate steps to ensure that the organization makes a declaration in accordance with the preceding paragraph.

3. If an international intergovernmental organization is liable for damage by virtue of the provisions of this Convention, that organization and those of its members which are States Parties to this Convention shall be jointly and severally liable; provided, however, that:

(a) Any claim for compensation in respect of such damage shall be first presented to the organization;

(b) Only where the organization has not paid, within a period of six months, any sum agreed or determined to be due as compensation for such damage, may the claimant State invoke the liability of the members which are States Parties to this Convention for the payment of that sum.

4. Any claim, pursuant to the provisions of this Convention, for compensation in respect of damage caused to an organization which has made a declaration in accordance with paragraph 1 of this article shall be presented by a State member of the organization which is a State Party to this Convention.

Article XXIII

1. The provisions of this Convention shall not affect other international agreements in force insofar as relations between the States Parties to such agreements are concerned.

2. No provision of this Convention shall prevent States from concluding international agreements reaffirming, supplementing or extending its provisions.

Article XXIV

1. This Convention shall be open to all States for signature. Any State which does not sign this Convention before its entry into force in accordance with paragraph 3 of this article may accede to it at any time.

2. This Convention shall be subject to ratification by signatory States. Instruments of ratification and instruments of accession shall be deposited with the Governments of the Union of Soviet Socialist Republics, the United Kingdom of Great Britain and Northern Ireland and the United States of America, which are hereby designated the Depositary Governments.

3. This Convention shall enter into force on the deposit of the fifth instrument of ratification.

4. For States whose instruments of ratification or accession are deposited subsequent to the entry into force of this Convention, it shall enter into force on the date of the deposit of their instruments of ratification or accession.

5. The Depositary Governments shall promptly inform all signatory and acceding States of the date of each signature, the date of deposit of each instrument of ratification of and accession to this Convention, the date of its entry into force and other notices.

6. This Convention shall be registered by the Depositary Governments pursuant to Article 102 of the Charter of the United Nations.

Article XXV

Any State Party to this Convention may propose amendments to this Convention. Amendments shall enter into force for each State Party to the Convention accepting the amendments upon their acceptance by a majority of the States Parties to the Convention and thereafter for each remaining State Party to the Convention on the date of acceptance by it.

Article XXVI

Ten years after the entry into force of this Convention, the question of the review of this Convention shall be included in the provisional agenda of the United Nations General Assembly in order to consider, in the light of past application of vention has been in force for five years, and at the request of one-third of the the Convention, whether it requires revision. However, at any time after the Con-

States Parties to the Convention, and with the concurrence of the majority of the States Parties, a conference of the States Parties shall be convened to review this Convention.

Article XXVII

Any State Party to this Convention may give notice of its withdrawal from the Convention one year after its entry into force by written notificaion to the Depositary Governments. Such withdrawal shall take effect one year from the date of receipt of this notification.

Article XXVIII

This Convention, of which the Chinese, English, French, Russian and Spanish texts are equally authentic, shall be deposited in the archives of the Depositary Governments. Duly certified copies of this Convention shall be transmitted by the Depositary Governments to the Governments of the signatory and acceding States.

IN WITNESS WHEREOF the undersigned, duly authorized, have signed this Convention.

DONE in _____, at the cities of London, Moscow and Washington, the _____ day of _____ one thousand nine hundred and _____.

List of States that have Deposited Instruments of Ratification of (or accession to) the Convention on International Liability for Damage Caused by Space Objects. Done at Washington, London and Moscow, March 29, 1972. (U.S. Senate advice and consent to ratification given October 6, 1972; ratified by the President May 18, 1973; ratification deposited October 9, 1973. Entered into force for the United States on October 9, 1973 "Treaties and Other International Acts" (TIAS 7762).

Totals as of July 1975:

Signatures: 71 plus the Ukrainian S. S. R. and Byelorussian S. S. R.
Ratifications: 28 plus the Ukrainian S. S. R.
Accessions: 6.

THE SPACE LIABILITY CONVENTION

Country	Washington		Moscow[1]		London[1]	
	Signature	Ratification	Signature	Ratification	Signature	Ratification
United States	Mar. 29, 1972	Oct. 9, 1973	Mar. 29, 1972	Oct. 9, 1973	Mar. 29, 1972	Oct. 9, 1973
Algeria					Apr. 20, 1972	
Argentina	Mar. 29, 1972		Mar. 29, 1972		Apr. 5, 1972	
Austria	May 30, 1972		May 30, 1972		May 30, 1972	
Belgium	Mar. 29, 1972		Mar. 29, 1972		Mar. 29, 1972	
Botswana	do	Mar. 11, 1974				
Brazil	July 13, 1972	Mar. 9, 1973	July 13, 1972	Mar. 9, 1973	July 13, 1972	Mar. 9, 1973
Bulgaria	Mar. 29, 1972	June 14, 1972	Mar. 29, 1972	May 14, 1973	Mar. 29, 1972	May 16, 1972
Burundi	do					
Byelorussian Soviet Socialist Republic.[2]			Mar. 29, 1972			
Central African Republic.	Apr. 27, 1972					
China, Republic of	Mar. 29, 1972	Feb. 9, 1973				
Colombia	do					
Costa Rica	do					
Cyprus	May 12, 1972	May 23, 1973	May 5, 1972	May 23, 1973	Apr. 28, 1972	May 15, 1973
Czechoslovakia	Mar. 29, 1972		Mar. 29, 1972		Mar. 29, 1972	
Dahomey	do	Apr. 25, 1975				
Denmark	Apr. 19, 1972		Apr. 19, 1972		Apr. 19, 1972	
Dominican Republic	Apr. 26, 1972	Feb. 23, 1973				
Ecuador	Apr. 25, 1972	Aug. 17, 1972				
Egypt, Arab Republic of			May 19, 1972		June 6, 1972	
El Salvador	Mar. 29, 1972					
Finland	do		Mar. 29, 1972		Mar. 29, 1972	
Gambia	June 2, 1972		June 2, 1972		Aug. 8, 1972	
German Democratic Republic.			Mar. 29, 1972	Aug. 30, 1972		
Ghana	Mar. 31, 1972		do			
Greece	Apr. 12, 1972[3]					
Guatemala	Mar. 29, 1972					
Haiti	do					
Honduras	do					
Hungary	do	Dec. 27, 1972	Mar. 29, 1972	Dec. 27, 1972	Mar. 29, 1972	Dec. 27, 1972
Iceland	do		do		do	
Iran	do	Feb. 13, 1974	do		do	
Ireland	do	June 29, 1972[4]			do	[4] June 29, 1972
Italy	do		Mar. 29, 1972		Apr. 14, 1972	
Jordan	May 25, 1972		June 6, 1972			
Khmer Republic	Mar. 29, 1972					
Korea, Republic of	do.[5]				Mar. 29, 1972[5]	
Kuwait	June 7, 1972	Nov. 15, 1972	June 9, 1972	Nov. 23, 1972	June 29, 1972	Oct. 30, 1972
Laos	Mar. 29, 1972	Mar. 22, 1973	Mar. 31, 1972	Mar. 29, 1973	Mar. 29, 1972	Apr. 25, 1973
Lebanon	do		Apr. 21, 1972		do	
Luxembourg	Apr. 25, 1972		May 10, 1972		Apr. 27, 1972	
Mali	Apr. 18, 1972	June 8, 1972	Apr. 4, 1972			
Mexico	Mar. 29, 1972	Apr. 6, 1974	Mar. 29, 1972		Mar. 29, 1972	Apr. 9, 1974
Mongolia	Apr. 18, 1972	Sept. 5, 1972	do	Oct. 20, 1972	do	Sept. 14, 1972
Morocco	Mar. 29, 1972		Apr. 5, 1972		Apr. 4, 1972	
Nepal	June 19, 1972		Mar. 29, 1972		Mar. 29, 1972	
New Zealand	do	Oct. 30, 1974[6]	June 22, 1972		June 19, 1972	[6] Oct. 30, 1974
Nicaragua	Mar. 29, 1972				Apr. 11, 1972	

See footnotes at end of table, p. 69.

THE SPACE LIABILITY CONVENTION—Continued

Country	Washington		Moscow[1]		London[1]	
	Signature	Ratification	Signature	Ratification	Signature	Ratification
Niger	May 24, 1972	Sept. 1, 1972				
Norway	Mar. 29, 1972		Mar. 29, 1972		Mar. 29, 1972	
Oman					June 22, 1972	
Pakistan	Aug. 14, 1972	Apr. 4, 1973	July 7, 1972	May 29, 1972	July 6, 1972	Apr. 14, 1973
Panama		June 5, 1974			Mar. 29, 1972	
Peru	Apr. 10, 1972					
Philippines	Aug. 22, 1972					
Poland	Mar. 29, 1972	Jan. 25, 1973	Mar. 29, 1972	Jan. 25, 1973	Mar. 29, 1972	Jan. 25, 1973
Romania	do		do		do	
Rwanda	do		do			
Senegal	Apr. 14, 1972	Mar. 26, 1975				
Sierra Leone	July 17, 1972		July 14, 1972			
Singapore	July 19, 1972		July 19, 1972		July 19, 1972	
Spain	Mar. 29, 1972					
South Africa	do					
Switzerland	do	Jan. 22, 1974	Mar. 29, 1972		Mar. 29, 1972	
Tanzania	May 31, 1972					
Togo	Apr. 19, 1972					
Tunisia	Mar. 29, 1972	May 14, 1973	Apr. 3, 1972	May 29, 1973	Apr. 6, 1972	June 6, 1973
Ukrainian SSR[2]			Mar. 29, 1972	Oct. 9, 1973		
U.S.S.R.	Mar. 29, 1972	Oct. 9, 1973	do	Oct. 9, 1973	Mar. 29, 1972	Oct. 9, 1973
United Kingdom	do	do	do	do	do	
Venezuela	do					
Zaire	do		Apr. 4, 1972			

	Accession	Accession	Accession
Iran		Oct. 4, 1972	
Fiji	Apr. 4, 1973	May 14, 1973	May 4, 1973
St Lucia	Apr. 2, 1979	Apr. 2, 1979	May 2, 1979
Zambia	Aug. 29, 1973	Aug. 21, 1973	Aug. 29, 1973
Australia	Jan. 29, 1975		Jan. 29, 1975
Canada	Feb. 28, 1975[3]		Feb. 28, 1975[3]

[1] The listings for signings in Moscow and London are based upon official reports received.
[2] The United States considers this Republic as already covered by the signature affixed to the treaty by the U.S.S.R.
[3] With reservation.
[4] With declaration.

APPENDIX B
PRESIDENT CARTER'S SPACE DIRECTIVES

WHITE HOUSE PRESS RELEASE (DESCRIPTION OF A PRESIDENTIAL DIRECTIVE ON NATIONAL SPACE POLICY)

THE WHITE HOUSE,
June 20, 1978.

The President directed under a Presidential Review Memorandum that the NSC Policy Review Committee (PRC) thoroughly review existing policy and formulate overall principles which should guide our space activities. The major concerns that prompted this review arose from growing interaction among our various space activities.

This review examined and the resultant Presidential Directive establishes:

A government policy oversight system to review and revise space policy as needed;

Ground rules for the balance and interaction among our space programs to insure achievement of the interrelated national security, economic, political, and arms limitation goals of the U.S.; and

Modifications to existing policies, the appropriate extent of the overlapping technology, and product dissemination by the sectors.

This Presidential Directive establishes an NSC Policy Review Committee to provide a forum to all Federal agencies for their policy views, to advise on proposed changes to national space policy, to resolve issues referred to the Committee, and to provide for rapid referral of issues to the President for decision as necessary. This Committee will be chaired by the Director of the Office of Science and Technology Policy, Frank Press. Recognizing that the civilian space program is at the threshold of change, the President has asked the PRC to assess the needs and aspirations of the nation's civil space program. The United States has built a broad national base in space and aeronautics. At issue is how best to capitalize on prior investments and set the needed direction and purpose for continued vitality in the future.

Under the Presidential Review Memorandum the emphasis was to resolve potential conflicts among the various space program sectors and to recommend coherent space principles and national space policy. In focusing upon these issues, the Policy Review Committee concluded that our current direction set forth in the Space Act of 1958 is well founded and that the preponderence of existing problems was related to interactions and resultant stresses among the various space programs. For this reason, the classified portion of the recently signed Presidential Directive concentrates on overlap questions. It does not deal in detail with the long-term objectives of our defense, commercial, and civil programs. Determining our civil space policy, outlined above, will be the next step.

As a result of this in-depth review, the President's Directive establishes national policies to guide the conduct of United States activities in and related to space programs. The objectives are (1) to advance the interests of the United States through the exploration and use of space and (2) to cooperate with other nations in maintaining the freedom of space for all activities which enhance the security and welfare of mankind. The space principles set forth in this Directive are:

The United States will pursue space activities to increase scientific knowledge, develop useful commercial and government applications of space technology, and maintain United States leadership in space technology.

The United States is committed to the principles of the exploration and use of outer space by all nations for peaceful purposes and for the benefit of all mankind.

The United States is committed to the exploration and use of outer space in support of its national well-being.

The United States rejects any claims to sovereignty over outer space or over celestial bodies, or any portion thereof, and rejects any limitations on the fundamental right to acquire data from space.

The United States holds that the space systems of any nation are national property and have the right of passage through and operations in space without interference. Purposeful interference with space systems shall be viewed as an infringement upon sovereign rights.

The United States will pursue activities in space in support of its right of self-defense and thereby strengthen national security, the deterrence of attack, and arms control agreements.

The United States will conduct international cooperative space activities that are beneficial to the United States scientifically, politically, economically, and/or militarily.

The United States will develop and operate on a global basis active and passive remote sensing operations in support of national objectives.

The United States will maintain current responsibility and management relationships among the various space programs, and, as such, close coordination and information exchange will be maintained among the space sectors to avoid unnecessary duplication and to allow maximum cross-utilization of all capabilities.

Our civil space programs will be conducted to increase the body of scientific knowledge about the earth and the universe; to develop and operate civil applications of space technology; to maintain United States leadership in space science, applications, and technology; and to further United States domestic and foreign policy objectives within the following guidelines:

The United States will encourage domestic commercial exploitation of space capabilities and systems for economic benefit and to promote the technological position of the United States; however, all United States earth-oriented remote sensing satellites will require United States government authorization and supervision or regulation.

Advances in earth imaging from space will be permitted under controls and when such needs are justified and assessed in relation to civil benefits, national security, and foreign policy. Controls, as appropriate, on other forms of remote earth sensing will be established.

Data and results from the civil space programs will be provided the widest practical dissemination to improve the condition of human beings on earth and to provide improved space services for the United States and other nations of the world.

The United States will develop, manage, and operate a fully operational Space Transportation System (STS) through NASA, in cooperation with the Department of Defense. The STS will service all authorized space users—domestic and foreign commercial and governmental—and will provide launch priority and necessary security to national security missions while recognizing the essentially open character of the civil space program.

Our national security related space programs will conduct those activities in space which are necessary to our support of such functions as command and control, communications, navigation, environmental monitoring, warning and surveillance, and space defense as well as to support the formulation and execution of national policies; and to support the planning for and conduct of military operations. These programs will be conducted within the following guidelines:

Security, including dissemination of data, shall be conducted in accordance with Executive Orders and applicable directives for protection of national security information. Space-related products and technology shall be afforded lower or no classification where possible to permit wider use of our total national space capability.

The Secretary of Defense will establish a program for identifying and integrating, as appropriate, civil and commercial resources into military operations during national emergencies declared by the President.

Survivability of space systems will be pursued commensurate with the planned need in crisis and war and the availability of other assets to perform the mission. Identified deficiencies will be eliminated and an aggressive, long-term program will be applied to provide more assured survivability through evolutionary changes to space systems.

The United States finds itself under increasing pressure to field an anti-satellite capability of its own in response to Soviet activities in this area. By exercising mutual restraint, the United States and the Soviet Union have an opportunity at this early juncture to stop an unhealthy arms competition in space before the competition develops a momentum of its own. The two countries have commenced bilateral discussions on limiting certain activities directed against space objects, which we anticipate will be consistent with the overall U.S. goal of maintaining any nation's right of passage through and operations in space without interference.

While the United States seeks verifiable, comprehensive limits on anti-satellite capabilities and use, in the absence of such an agreement, the United States will vigorously pursue development of its own capabilities. The U.S. space defense program shall include an integrated attack warning, notification, verification, and contingency reaction capability which can effectively detect and react to threats to U.S. space systems.

THE WHITE HOUSE—OCTOBER 11, 1978

FACT SHEET

U.S. CIVIL SPACE POLICY

The President announced today a space policy that will set the direction of U.S. efforts in space over the next decade. The policy is the result of a 4-month interagency review requested by the President in June 1978. American civil space policy will be centered around three tenets:

First.—Our space policy will reflect a balanced strategy of applications, science and technology development containing essential key elements that will:

Emphasize space applications that will bring important benefits to our understanding of Earth resources, climate, weather, pollution and agriculture, and provide for the private sector to take an increasing responsibility in remote sensing and other applications.

Emphasize space science and exploration in a manner that retains the challenge and excitement and permits the Nation to retain the vitality of its space technology base, yet provides short-term flexibility to impose fiscal constraints when conditions warrant.

Take advantage of the flexibility of the Space Shuttle to reduce the cost of operating in space over the next two decades to meet national needs.

Increase benefits for resources expended through better integration and technology transfer among the national space programs and through more joint projects when appropriate, thereby increasing the return on the $100 billion investment in space to the benefit of the American people.

Assure American scientific and technological leadership in space for the security and welfare of the Nation and continue R. & D. necessary to provide the basis for later programmatic decisions.

Demonstrate advanced technological capabilities in open and imaginative ways having benefit for developing as well as developed countries.

Foster space cooperation with nations by conducting joint programs.

Confirm our support of the continued development of a legal regime for space that will assure its safe and peaceful use for the benefit of mankind.

Second.—More and more, space is becoming a place to work—an extension of our environment. In the future, activities will be pursued in space when it appears that national objectives can most efficiently be met through space activities.

Third.—It is neither feasible nor necessary at this time to commit the United States to a high-challenge space engineering initiative comparable to Apollo. As the resources and manpower requirements for Shuttle development phase down, we will have the flexibility to give greater attention to new space applications and exploration, continue programs at present levels or contract them. To meet the objectives specified above, an adequate Federal budget commitment will be made.

Space applications

As a part of his overall review and in accordance with his desire to increase emphasis on uses of space for a wide variety of practical and economic benefits the President made the following decisions:

Remote sensing systems.—Since 1972 the United States has conducted experimental civil remote sensing through Landsat satellites. There are many successful applications and users, including Federal departments, other nations, a number of States, and a growing number of commercial organizations. The United States will continue to provide data from the developmental Landsat program for all classes of users. Operational uses of data from the experimental system will continue to be made by public, private, and international users. Specific details and configurations of the Landsat system and its management and organizational factors will evolve over the next several years to arrive at the appropriate technology mix, test organizational arrangements, and develop the potential to involve the private sector.

Integrated remote sensing system.—A comprehensive plan covering expected technical, programmatic, private sector, and institutional arrangements for remote sensing will be explored. NASA will chair an interagency task force to examine options for integrating current and future systems into an integrated national system. Emphasis will be placed on defining and meeting user requirements. This task force will complete its review prior to the fiscal year 1981 budget cycle.

Weather satellites.—Separate operational requirements for meteorological data over the past two decades have led to separate Defense and Commerce's National Oceanic and Atmospheric Administration (NOAA) weather satellites. The Defense community, NASA, and NOAA will conduct a review of meteorological satellite programs to determine the degree to which these programs might be consolidated in the 1980's and the extent to which separate programs supporting specialized defense needs should be maintained. The possibility of integrated systems for ocean observations from space will also be examined.

The private sector.—Along with other appropriate agencies, NASA and Commerce will prepare a plan of action on how to encourage private investment and direct participation in civil remote sensing systems. NASA and Commerce will be the contacts for the private sector on this matter and will analyze proposals received before submitting to the Policy Review Committee (Space) for consideration and action.

Communications satellite R. & D.—U.S. leadership in communications satellite systems will be supported by NASA. Selected technological opportunities to provide better frequency and orbit utilization and other longer term opportunities will be pursued.

Communications satellite services.—Some areas of communications services—such as educational and health services and basic communications services for remote areas—involve low-volume and intermittent use and have evidenced little interest from commercial satellite operators. The Department of Commerce's National Telecommunications and Information Administration (NTIA) will assist in market aggregation, technology transfer, and possible development of domestic and international public satellite services. This direction is intended to stimulate the aggregation of the public service market drawing on

the technology that is already in existence. The Agency for International Development and Interior will work with NTIA in translating domestic experience in public service programs into potential programs for lesser developed countries and the remote territories.

Future applications and economic activity.—It is too early to make a commitment to the development of a satellite solar power station or space manufacturing facility due to the uncertainty of the technology and economic cost-benefits and environmental concerns. There are, however, very useful intermediate steps that will allow the development and testing of key technologies and experience in space industrial operations to be gained. The United States will pursue an evolutionary program that is directed toward assessing new options which will be reviewed periodically by the Policy Review Committee (Space). The evolutionary program will stress science and basic technology—integrated with a complementary ground R. & D. program—and will continue to evaluate the relative costs and benefits of proposed activities.

Space science and exploration

The President reviewed the space science and planetary exploration program and determined that the U.S. priorities at any given time will depend on the promise of the science, the availability of the particular technology, and the budgetary situation. The United States will maintain a position of leadership in space science and planetary exploration and will:

Continue a vigorous program of planetary exploration to understand the origin and evolution of the solar system. The goal in the years ahead is to continue the reconnaissance of the outer planets and to conduct more detailed exploration of Saturn, its moons, and its rings; to continue comparative studies of the neighboring planets, Venus and Mars; and to conduct reconnaissance of comets and asteroids.

Utilize the space telescope and free-flying satellites to usher in a new era of astronomy, as we explore interstellar molecules, quasars, pulsars, and black holes to expand our understanding of the universe.

Develop a better understanding of the Sun and its interaction with the terrestrial environment through space systems—such as the Solar Maximum Mission and the Solar Polar Mission—that will journey toward the Sun and Earth-orbiting satellites that will measure the variation in solar output and determine the resultant response of the Earth's atmosphere.

Utilize the Space Shuttle and Spacelab, alone and in cooperation with other nations, to conduct basic research that complements Earth-based life science investigations and human physiology research.

Our policy in international space cooperation will include two basic elements: (1) to pursue the best science available regardless of national origin and expand our international planning and coordinating effort; and (2) to seek cooperative support for experiments-spacecraft which have been chosen on sound scientific criteria.

Increased benefit for resources expended

As a result of the President's review, decisions were made that will increase the benefit to the United States for resources expended.

Strategy to utilize the Shuttle.—The administration will make incremental improvements in the Shuttle transportation system as they become necessary. Decisions on extending the Shuttle's stay time in orbit and future upper stage capabilities (e.g., the reusable space tug and orbital transfer vehicle) will be examined in the context of our emerging space policy goals. An interagency task force will make recommendations on what future capabilities are needed. This task force will submit the findings to the Policy Review Committee (Space) prior to the fiscal year 1981 budget cycle.

Technology sharing.—The Policy Review Committee (Space) will take steps to enhance technology transfer between the space sectors. The objective will be to maximize efficient utilization of the sectors while maintaining necessary security and current management relationships.

Background

Early in his administration, the President directed a National Security Council review of space policy. The emphasis was on coherent space principles and national space policy and did not deal in detail with the long-term objectives of our defense, commercial, and civil programs. The review, completed in May 1978, resulted in a Presidential Directive that set the basic framework for our civil space policy completed last week. The President's May 1978 directive established a Policy Review Committee (Space) to provide a forum for all Federal agencies in which to advise on proposed changes to national space policy and to provide for rapid referral of issues to the President for decision. This Committee is chaired by the Director of the Office of Science and Technology Policy, Frank Press. In June 1978 the President directed the Policy Review Committee (Space) to assess the future needs of the Nation's civil space program, and their report formed the basis for the policy decisions outlined here. The following agencies and departments participated: The National Aeronautics and Space Administration, Commerce, Interior, Agriculture, Energy, State, National Science Foundation, Agency for International Development, Defense, Director of Central Intelligence, Joint Chiefs of Staff, and Arms Control and Disarmament Agency, as well as the Domestic Policy Staff, the National Security Council Staff, and the Office of Management and Budget.

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GLOSSARY OF ACRONYMS

AACB	Aeronautics and Astronautics Coordinating Board
ACDA	Arms Control and Disarmament Agency
ABM	antiballistic missile
ABMA	Army Ballistic Missile Agency
ADC	Aerospace Defense Center
ADCOM	Aerospace Defense Command
AEC	Atomic Energy Commission
AFM	Air Force Manual
AFSATCOM	Air Force Satellite Communications
AFSC	Air Force Systems Command
ARDC	Air Research and Development Command
ARPA	Advanced Research Projects Agency
ASAT	antisatellite
ASTP	Apollo-Soyuz Test Program
CSOC	Consolidated Space Operations Center
DARPA	Defense Advanced Research Projects Agency
DCSO	Deputy Commander for Space Operations
DMSP	Defense Meteorological Satellite Program
DOC	Department of Commerce
DOD	Department of Defense
DOE	Department of Energy
DOS	Department of State
DSCS	Defense Satellite Communications System
ELV	expendable launch vehicle
ESA	European Space Agency
FLTSATCOM	Fleet Satellite Communications
FOBS	fractional orbital bombardment satellite
FY	fiscal year
GMF	ground mobile forces
GPS	Global Positioning System
ICBM	Intercontinental Ballistic Missile

IOC	Initial Operational Capability
IRBM	Intermediate Range Ballistic Missile
IGY	International Geophysical Year
JPL	Jet Propulsion Laboratory (California Institute of Technology)
MAJCOM	major command (USAF)
MILSATCOM	military satellite communications
MOL	manned orbital laboratory
NACA	National Advisory Committee for Aeronautics
NACAA	National Advisory Committee for Aeronautics and Astronautics
NAS	National Academy of Science
NASA	National Aeronautics and Space Administration
NAS Act	National Aeronautics and Space Act of 1958 (Public Law 85–568)
NASC	National Aeronautics and Space Council
NCA	national command authority
NOAA	National Oceanographic and Atmospheric Agency
NRL	Naval Research Laboratory
NSC	National Security Council
NSF	National Science Foundation
OMB	Office of Management and Budget
OSD	Office of the Secretary of Defense
OST	Outer Space Treaty
OSTP	Office of Science and Technology Policy
PD	Presidential Directive
PPBS	Planning, Programing and Budgeting System
PRC	Presidential Review Committee
PSAC	President's Scientific Advisory Committee
R&D	research and development
SAC	Strategic Air Command
SMOPS	Space Mission Organization Planning Study
SRF	strategic rocket force
STG	Space Task Group
STS	Space Transportation System
TAOS	Thrust-Assisted Orbiter System

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